A Fish Consumption Survey
of the
[Shoshone-Bannock Tribes] [Nez Perce Tribe]
Combination Draft Final Report

*****Note: there will be a separate final report for each of the Tribes in September, 2015. *****

Volume II—Current Fish Consumption Survey

July 30, 2015

Preface

[NPT]
This report of fish consumption rates among the Nez Perce Tribe is a step toward quantitatively documenting the role of fish in the life of the Tribe. The authors of this report hope that this work will help to protect the health of tribal members and Idaho residents who are fish consumers, especially those who enjoy a high fish consumption rate.

While the results of this report are numeric, the numbers are only a companion to the Nez Perce culture, heritage and vision for their future. It may help the readers to know more about the Nez Perce Tribe, the role of fish in the lives of its members and the activities of the Tribe in relation to fish and fishing. Volume I of this report on heritage fish consumption rates includes material that provides a better understanding of the Tribe's longstanding relationship and dependence on fish and fishing.

***NOTE**: A decision on appendix G is pending. The Nez Perce may wish to insert a foreword in lieu or in place of Appendix G.*
The Nez Perce Tribe Final Survey Design document provides more detailed information on the Nez Perce Tribe. The design report covers a number of topics, including the background and purpose of the survey, the survey objectives for the Tribe, the importance of heritage fish consumption rates to the Tribe, the suppression of fish consumption over time, the role of the current survey and a historic assessment. (See Appendix G, Design of a Survey on Fish Consumption by the Nez Perce Tribe.)

[SBT]
This report of fish consumption rates among the Shoshone-Bannock Tribes is a step toward quantitatively documenting the role of fish in the life of the Tribes. The authors of this report hope that this work will help to protect the health of tribal members and Idaho residents who are fish consumers, especially those who enjoy a high fish consumption rate.

While the main results of this report are numeric, the numbers are only a companion to the Shoshone-Bannock culture, heritage and vision for their future. It may help the readers to know more about the Shoshone-Bannock Tribes, the role of fish in the lives of their members and the activities of the Tribe in relation to their fisheries. Volume I of this report on heritage fish consumption rates includes material that provides a better understanding of the Tribe's longstanding relationship to and dependence on to fish and fishing. In addition, the Foreword, the next section of this report, is authored by the staff of the Shoshone-Bannock Tribes. The sections following the Shoshone-Bannock Foreword are authored by those listed on the title page.

[BOTH]
About this report version. This is a draft report based on all survey data collected for the purpose of calculating fish consumption rates. The report also presents results based on other information provided by respondents, such as frequency of fishing and other fish-related activities. The report includes text, figures and tables both for the Nez Perce Tribe and for the Shoshone-Bannock Tribes. It is a "combination" report. This combination approach has saved

considerable time and effort during the development of the report and will save time as reviews of the combination report are received and incorporated.

The reader will note that sections of the material in this combination report are labeled as "BOTH," "NPT," or "SBT," referring to text, tables or figures that apply to both tribes, to the Nez Perce Tribe or to the Shoshone-Bannock Tribes, respectively. Once one of the designations is encountered in the text, the subsequent material applies to one or to both Tribes until the next such designation is encountered.

A final version of this report will be issued in September 2015, after the results of a peer review have been assimilated and incorporated. At that time, separate final reports will be issued for the Nez Perce Tribe and for the Shoshone-Bannock Tribes.

[SBT]

Foreword by the Shoshone-Bannock Tribes

The Shoshone-Bannock Tribes of today are a self-governing, Federally Recognized Tribe with reserved off-Reservation Treaty rights secured by the Fort Bridger Treaty of July 3, 1868.[1] The Fort Hall reservation, permanent homeland of the Tribes, is located in Southeastern Idaho near the city of Pocatello. The Snake and Blackfoot rivers provide for the western and northern reservation boundaries and the Portneuf River begins and ends on the reservation.

The enrolled members of the Shoshone-Bannock Tribes are descendants of speakers of Shoshone and Northern Paiute (of which Bannock is a dialect) who lived and traveled in southern Idaho and adjoining regions of Oregon, Nevada, Utah, Wyoming, and Montana in historic times. They most intensively utilized and traveled the rivers and tributaries of the Salmon and Snake, which in turn feed the Columbia River drainage system, but they also spent time on watercourses leading to the Great Basin as well as the Missouri and Colorado rivers (Albers, 1998, pp. 2-3). The manner in which they travelled was denoted as *devewah*, meaning, wherever you could safely stay and gather food resources. The Tribes' name for themselves was actually *newe* or *newe'ne* in Shoshone.

Early observers used the name "Snake" interchangeably for people who spoke the Shoshone and Northern Paiute languages, and they applied it widely across the vast stretches of territory occupied by Shoshone-Bannock people of diverse location and differing circumstance. Historically, Shoshone and Bannock speakers commonly identified themselves and the people who lived around them by names which designated a prominent geographic feature or important food taken at the locales through which they traveled. Often, the same names were attached to peoples residing in different places. *Agaideka*, "Eaters of Salmon," was used to simultaneously

[1] [SBT only] Article IV of the Fort Bridger Treaty reads: "The Indians herein named agree, when the agency house and other buildings shall be constructed on their reservations named, they will make said reservations their permanent home, and they will make no permanent settlement elsewhere; but they shall have the right to hunt on the unoccupied lands of the United States so long as game may be found thereon, and so long as peace subsists among the whites and Indians on the borders of the hunting districts." Quoted from: http://digital.library.okstate.edu/kappler/Vol2/treaties/sho1020.htm#mn4

identify people on the Salmon and Lemhi Rivers as well as those near the middle reaches of the Snake River below Shoshone Falls, while *Pengwedeka,* "Eaters of Fish," applied to Shoshone-Bannock who wintered near Camas Creek and those who wintered near the mouth of the Bear River (Albers, 1998, pp. 4, 7, 8).

A person's place in the world and that of their kindred was not identified by a single location but by the range of territories in which they moved to secure their sustenance. As Sven Liljeblad put it, a territory was called *tebi'wa,* "native land," which was "anywhere…he could find something to eat." In historic times, before the era of treaty-making, Shoshone-Bannock subsistence rested on a variety of different kinds of procurement which included fishing, hunting, and plant gathering. How these activities were carried out and where they took place, however, varied across time and location. No matter what their particular character, these activities involved mobility. They required people to move from place to place, disband and regroup according to the natural cycles of the resources they depended upon (Albers, 1998, pp. 10-11).

The reservation was initially established by Executive Order in June 1867, as a place to consolidate the widely dispersed populations of Shoshone and Bannock ancestry in southern Idaho and adjacent areas in Utah, Nevada, Oregon, and Montana. The effective founding of the reservation came in the Spring of 1869, when the government relocated the people known in the historic record as the Boise and Bruneau Shoshones, who originally resided across a wide area along the middle and lower course of the Snake River, to Fort Hall. In the following decades, additional Shoshone- and Bannock-speaking peoples whose traditional territorial ranges encompassed the Idaho-Utah border regions, interior Oregon, Wyoming, and Montana also became affiliated with Fort Hall. Included in those who were eventually incorporated into the reservation were bands from eastern Oregon, the Weiser River and McCall areas. Finally, when the Lemhi Reservation was closed in 1907, hundreds of additional Shoshone-Bannock, who historically lived and traveled in the Salmon River country and adjacent portions of Montana, were placed under the administrative umbrella of Fort Hall (Albers, 1998, pp. 13-14).

Even though Shoshone-Bannock peoples fished at different times and places, and even though they varied in their relative reliance on specific fisheries, it can be said with total confidence that all of those who lived in Idaho during historic times procured fish as a basic part of their diet (Albers, 1998, p. 17).

Of particular note, as mentioned above, were the *Agaideka,* or salmon-eaters. In his 1843 journals, explorer John C. Fremont describes the following scene at what is today Shoshone Falls:

> "Our encampment was about one mile below the Fishing falls . . . and the great fisheries from which the inhabitants of this barren region almost entirely derive a subsistence commence at this place. . . . The Indians made us comprehend, that when the salmon came up the river in the spring, they are so abundant that they merely throw in their spears at random, certain of bringing out fish. . . . they are still a joyous talkative race, who grow fat and become

> poor with the salmon, which at least never fail them—the dried being used in the absence of the fresh."

The 1868 Fort Bridger Treaty provided the language through which the Shoshone-Bannock have continued to enforce their hunting and fishing rights through to the present day. The stated mission of the Shoshone-Bannock Tribes Fish and Wildlife Department is "to protect, restore, and enhance fish and wildlife-related resources in accordance with the Tribes' unique interests and vested rights in such resources and their habitats, including the inherent, aboriginal and treaty protected rights of Tribal members to fair process and the priority rights to harvest pursuant to the Fort Bridger Treaty of July 3, 1868."

The Shoshone-Bannock Tribes were the first to petition the National Marine Fisheries Service to list Snake River sockeye salmon as endangered (which the NMFS did in November 1991 under the Endangered Species Act). Since then, the Tribes have actively worked to increase the Snake River sockeye salmon population, with the end goal of de-listing the species and providing for tribal harvest opportunities.

On November 7, 2008, the Shoshone Bannock Tribes signed a Fish Accord with the federal action agencies—the U.S. Army Corps of Engineers, the Bureau of Reclamation, and the Bonneville Power Administration—to fund ongoing and new projects to benefit Snake River spring/summer Chinook, Snake River steelhead in the Salmon River basin, and Snake River sockeye and native yellow cutthroat in the Upper Snake River.

This Accord is funding activities over a 10-year period. Under it, the Shoshone Bannock Tribes will restore habitat, manage land for wildlife and native fish, supplement nutrients in streams, and develop and operate scientifically-managed hatchery additions to contribute to the recovery of Endangered Species Act-listed and non-listed fish and wildlife.

Table of Contents

List of Tables

NOTE: In this combination report, many table numbers appear twice. This is because the final report will be split into two versions later—one for each of the two Tribes. In the meantime, the page numbers in the List of Tables below show the location of the FIRST occurrence of each table. The second occurrence, if there is one, closely follows the first appearance. In addition, **each table title includes a reference to the Tribe(s) to which it refers.**

List of Figures

NOTE: In this combination report, some figure numbers appear twice. This is because the final report will be split into two versions later—one for each of the two Tribes. In the meantime, the page numbers in the List of Figures below show the location of the FIRST occurrence of each figure. The second occurrence, if there is one, closely follows the first appearance. In addition, **each figure title includes a reference to the Tribe(s) to which it refers.**

1.0 Acknowledgments

[NPT]
The authors wish to thank the following for invaluable help in designing and implementing the survey and in preparation of this report: the governing Council and staff of the Nez Perce Tribe; the staff of the Columbia River Inter-Tribal Fish Commission; the staff of EPA's Region 10 and its Conflict Prevention and Resolution Center; the staff of SRA International and Ross Strategic; the Nez Perce Tribal interviewers and other interviewers; the support staff of Pacific Market Research, Ridolfi, Inc., and The Mountain-Whisper-Light Statistics.

Most of all we wish to thank the members of the Nez Perce Tribe who served as respondents to this survey, patiently sitting through our long interviews and sharing important aspects of their lives. Without their stories, this report could not have been written.

[SBT]
The authors wish to thank the following for invaluable help in designing and implementing the survey and preparation of this report: the governing Council and staff of the Shoshone-Bannock Tribes; the staff of the Columbia River Inter-Tribal Fish Commission; the staff of EPA's Region 10 and EPA's Conflict Prevention and Resolution Center; the staff of SRA International and Ross Strategic; the Shoshone-Bannock Tribal interviewers and other interviewers; the support staff of Pacific Market Research, Ridolfi, Inc., and The Mountain-Whisper-Light Statistics.

Most of all we wish to thank the members of the Shoshone-Bannock Tribes who served as respondents to this survey, patiently sitting through our long interviews and sharing important aspects of their lives. Without their stories, this report could not have been written.

[BOTH]
We are grateful to all of those mentioned above, and to others who helped us. An important addition to any acknowledgment such as this is our affirmation that any errors of fact, method, numeric values or interpretation in this report belong to the authors and not to any of the people, organizations or sources that were consulted.

2.0 Acronyms

AWQC	Ambient Water Quality Criteria
CAPI	Computer-Assisted Personal Interviews
CRITFC	Columbia River Inter-Tribal Fish Commission
EPA	Environmental Protection Agency
FCR	Fish Consumption Rate(s)
FFQ	Food Frequency Questionnaire
HSSRO	Human Subjects Research Review Official
ID DEQ	Idaho Department of Environmental Quality
IRB	Institutional Review Board
NCI	National Cancer Institute
NPT	Nez Perce Tribe
SBT	Shoshone-Bannock Tribes
USRTF	Upper Snake River Tribes Foundation

3.0 Executive Summary

3.1 Introduction and Purpose

[NPT]
This is a report on fish consumption by the Nez Perce Tribe (NPT). The numeric fish consumption rates presented here are based on two statistical methods and two types of data used to estimate fish consumption rates. One method uses a food frequency questionnaire (FFQ), wherein survey respondents directly provide estimates per species of frequency of consumption, portion sizes and duration of their consumption seasons during the past year. The analysis results provide means and percentiles of fish consumption rates for the Nez Perce Tribe. The second statistical method uses responses to questions asked on two separate days about fish consumption "yesterday" (a 24-hour recall period). The 24-hour data along with some accepted and plausible statistical modeling yields, again, means and percentiles of fish consumption rates. The purpose of the report is to quantitatively describe current fish consumption and related activities of the Nez Perce Tribe. The fish consumption rates from this survey can be used by the Tribe, by the State of Idaho and by other bodies to inform and guide the effort to assess risks posed by contaminants in fish for populations with a high level of fish consumption.

The data analyzed in this report is based on interviews conducted from May 2014 to May 2015. The earliest in-person interview (including the FFQ and first 24-hour recall) that supplied useable data for this report occurred on May 10, 2014. The last in-person interview occurred on April 24, 2015. Telephone interviews continued through May 4, 2015 to complete the second 24-hour dietary recall interview.

[SBT]
This is a report on fish consumption by the Shoshone-Bannock Tribes (SBT). The numeric fish consumption rates presented here are based on two statistical methods and two types of data used to estimate fish consumption rates. One method uses a food frequency questionnaire (FFQ), wherein survey respondents directly provide estimates per species of frequency of consumption, portion sizes and duration of their consumption seasons during the past year. The analysis results provide means and percentiles of fish consumption rates for the Shoshone-Bannock Tribes. The second method uses responses to questions asked on two independent days about fish consumption "yesterday" (a 24-hour recall period). The 24-hour data along with some accepted and plausible statistical modeling yields, again, means and percentiles of fish consumption rates. The purpose of the survey is to quantitatively describe current fish consumption and related activities of the Shoshone-Bannock Tribes. The fish consumption rates from this survey can be used by the Tribes, by the State of Idaho and by other bodies to inform and guide the effort to assess risks posed by contaminants in fish for populations with a high level of fish consumption.

The data analyzed in this report is based on interviews conducted from May 2014 to May 2015. The earliest in-person interview (including the FFQ and the 24-hour recall) that supplied useable data for this report occurred on May 20, 2014. The last in-person interview occurred on April 26, 2015. Telephone interviews continued through May 3, 2015 to complete the second 24-hour dietary recall interview.

3.2 Survey Methods

[NPT]
The survey covered tribal members residing in ZIP codes falling within approximately 50 miles of two major tribal centers, Lapwai and Kamiah. The geographic scope was selected in consideration of the logistics of interviewers needing to reach respondents as well as to select a sample that would represent Nez Perce fish consumers specific to Idaho. A stratified random sample was drawn from tribal enrollment files, where the strata were defined by gender and age. The sample size of each stratum was chosen to be in proportion to the size of the stratum in the tribal enrollment file. Within each stratum, members were drawn randomly. Tribal fishers ("Tribal members who fish") were identified from a roster of tribal fishers maintained by the Tribe; a number of fishers were included in the sample and were interviewed. A fish consumption rate is reported for the fishers as a distinct population.

Tribal interviewers were employed and trained to administer the questionnaire. In order to facilitate coordination and maintain data quality, interviewers worked closely with the staff of the survey research firm charged with implementing the survey. Respondents were offered an incentive for participation in the survey. Respondents to the survey answered questions about species consumed (frequency and quantity), covering consumption over the past year, as well as answering questions about fish consumption "yesterday." The questions on 24-hour fish consumption "yesterday" were repeated in a separate interview (usually by telephone) administered on a later, independent day. An attempt was made to match the first and second interview timing during the seven days of the week so that the two interviews would either both be on a weekday or both be on a weekend day.

The questions about consumption over the past year followed the format of a food frequency questionnaire (FFQ), which is common in dietary studies. Additionally, data were collected on fish consumption "yesterday" (24-hour recall) for two independent days. The analysis of the FFQ data provides an estimated daily fish consumption rate in grams/day for each respondent and for any species or species group referenced in the survey. Data from the two 24-hour recall interviews were analyzed using the "NCI method"—a methodology developed by the National Cancer Institute and other researchers. The NCI method yields a distribution of the usual fish consumption rate in grams/day. The results of the NCI method are also presented here.

The statistical analysis included development of appropriate statistical weights in an effort to provide unbiased estimates of fish consumption for the Tribe. These weights are expected to correct for some or all of the potential response bias due to differential response rates across demographic groups of the Tribe. Specifically, there were fewer respondents than expected for some demographic groups. When this occurred, the respondents in this group needed to be given a greater weight so that the demographic group was appropriately reflected in the overall analysis. The mean, median and percentiles of fish consumption are reported for all species combined (species Group 1), for near coastal, estuarine, freshwater and anadromous species (species Group 2), and for other species groups. Additional fish consumption statistics are provided for demographic sub-groups of the Tribe.

This survey project includes an analysis of heritage rates—the fish consumption rates of the Tribe that were in place prior to modern environmental and social interference with its fishing practices. The current consumption rates presented here, combined with the heritage rates (see Volume I), provide a range of potential future fish-consuming populations (and associated fish consumption rates) to be considered in the effort to protect people with a high level of fish consumption.

[SBT]
The survey covered tribal members residing in ZIP codes falling within approximately 50 miles of two major tribal centers, Fort Hall and Blackfoot. The geographic scope was selected in consideration of the logistics of interviewers needing to reach respondents as well as to select a sample that represented Native American fish consumers specific to Idaho. A stratified random sample was drawn from tribal enrollment files, where strata were defined by age, residence on- or off-reservation and the presence on the tribal fishers list. Within each stratum, members were drawn randomly. A tribal fishers population for this study (referred to as the "fishers list" in this report) was taken from a list of tribal members who have attended Tribal Fish and Wildlife Department informational meetings to learn about fish run status and/or regulation changes and have submitted their contact information for any future informational outreach opportunities provided by the Fish and Wildlife Department. The individuals on the fishers list may or may not directly engage in fishing activities. The fishers constituted a separate, non-overlapping stratum. All fishers in this stratum were included in the sample. Fish consumption rates are reported for the fishers as a distinct population.

Tribal interviewers were employed and trained to administer the questionnaire. In order to facilitate coordination and maintain data quality, interviewers worked closely with the staff of the survey research firm charged with implementing the survey. Respondents were offered an incentive for participation in the survey. Respondents to the survey answered questions about species consumed (frequency and quantity) covering consumption over the past year, as well as questions about fish consumption "yesterday." The questions on 24-hour fish consumption "yesterday" were repeated in a separate interview (usually by telephone) administered on a later, different day. An attempt was made to match the timing of the first and second interviews during the seven days of the week so that the two interviews would either both be on a weekday or both be on a weekend day.

The questions about consumption over the past year followed the format of a food frequency questionnaire (FFQ), a common format in dietary studies. The analysis of the FFQ data provides an estimated daily fish consumption rate in grams/day for each respondent and for any species or species group referenced in the survey. Data from the two 24-hour recall interviews were analyzed using the "NCI method"—a methodology developed by the National Cancer Institute and other researchers. The NCI method yields a distribution of the usual fish consumption rate in grams/day. The results of the NCI method are also presented here.

The statistical analysis included development of appropriate statistical weights in an effort to provide unbiased estimates of fish consumption for the Tribes. These weights are expected to correct for some or all of the potential response bias due to differential response rates across demographic groups of the Tribes. Specifically, occasionally there were fewer respondents than

expected for a particular demographic group. When this occurred, the respondents in this group needed to be given a greater weight so that the demographic group was appropriately reflected in the overall analysis. The mean, median and percentiles of fish consumption are reported for all species (species Group 1) and for near coastal, estuarine, freshwater and anadromous species (species Group 2), and for other species groups. Additional fish consumption statistics are provided for demographic sub-groups of the Tribes.

This survey project includes an analysis of heritage rates—the fish consumption rates of the Tribes that were in place prior to modern environmental and social interference with their fishing practices. The current consumption rates presented here, together with the heritage rates (see Volume I), provide a range of potential future populations (and associated fish consumption rates) to be considered in the effort to protect people with a high level of fish consumption.

3.3 Results

[NPT]
A sample of 1,250 adult tribal members (age 18 or older) was drawn from enrollment files, representing 46% of the 2,727 adult members recorded in the files. Over the course of the interview period, 460 members were interviewed and provided sufficient information to classify them as fish consumers or non-consumers and to calculate an FFQ consumption rate for the consumers. The response rate for the survey is 38%. Only 9 of the respondents were non-consumers, and, using appropriate survey weighting, this count leads to an estimate of 3% non-consumers in the Tribe. The fish consumption rates for the Tribe are summarized briefly in Tables S1 and S2. Additional fish consumption rates are provided in the body of this report.

The Tribe's estimated current consumption rates are high relative to the U.S. general population (Table S3), and the rates for the population of fishers in the Tribe is substantially higher. The consumption rates are skewed toward large consumption rates for each of the population and species groups presented in Tables S1 and S2; the 95th percentile is several-fold larger than the median, typically an indication of skewness toward large values.

[NPT]

Table S1. Nez Perce Tribe. Mean, median and selected percentiles of FFQ and NCI method fish consumption rates (g/day); consumers only. Estimates are weighted.

			Percentiles			
Species	N Consumers	Mean	50%	90%	95%	99%
Group 1 - FFQ	451	123.4	70.5	270.1	437.4	795.9
Group 1 - NCI Method	451	75.0	49.5	173.2	232.1	
Group 2 - FFQ	446	104.0	61.3	231.4	327.9	764.5
Group 2 - NCI Method	446	66.5	36.0	159.4	233.9	

Table S2. Nez Perce Tribe. Mean, median and selected percentiles of FFQ and NCI method fish consumption rates (g/day) for fishers and non-fishers; consumers only. All rates are for total (all species, Group 1) consumption. Estimates are weighted.

			Percentiles		
Group	N Consumers	Mean	50%	90%	95%
Fishers - FFQ	138	171.8	98.0	436.8	543.5
Fishers - NCI Method	138	98.2	64.7	229.2	305.0
Non-fishers - FFQ	313	107.9	65.5	232.9	337.7
Non-fishers - NCI Method	313	67.6	45.6	155.1	206.0

[SBT]

A sample of 661 adult tribal members (age 18 or older) was drawn from enrollment files and the fishers list. Over the course of the interview period, 257 members were interviewed and provided sufficient information to classify them as fish consumers or non-consumers and to calculate an FFQ consumption rate for the consumers. The response rate for the survey is 42%. Thirty-one of the respondents were non-consumers, and, using appropriate survey weighting, this count leads to an estimate of 20% non-consumers in the Tribes. The fish consumption rates for the Tribes are summarized briefly in Tables S1 and S2. Additional fish consumption rates are provided in the body of this report.

The Tribes' estimated current consumption rates are high relative to the U.S. general population (Table S3). Fishers and non-fishers have similar mean rates, and there is no distinct pattern of consistently higher rates from one subgroup or the other in the median and other percentiles. The consumption rates are skewed toward large consumption rates for each of the populations and the species groups presented in Tables S1 and S2; the 95th percentile is several-fold larger than the median, typically an indication of skewness toward large values.

[SBT]

Table S1. Shoshone-Bannock Tribes. Mean, median and selected percentiles of FFQ and NCI method fish consumption rates (g/day); consumers only. Estimates are weighted.

			Percentiles			
Species	N Consumers	Mean	50%	90%	95%	99%
Group 1 - FFQ	226	158.5	74.6	392.5	603.4	1058.5
Group 1 - NCI Method	226	34.9	14.9	94.5	140.9	
Group 2 - FFQ	225	110.7	48.5	265.6	427.1	792.6
Group 2 - NCI Method	225	18.6	6.5	48.9	80.0	

Table S2. Shoshone-Bannock Tribes. Mean, median and selected percentiles of FFQ fish consumption rates (g/day) for fishers and non-fishers; consumers only. All rates are for total (all species, group 1) consumption. Estimates are weighted.

			Percentiles		
Group	N Consumers	Mean	50%	90%	95%
Fisher - FFQ	134	160.9	117.7	351.1	459.1
Fisher - NCI Method	134	42.4	20.0	114.3	163.6
Non-fisher - FFQ	92	158.2	69.7	405.4	604.4
Non-fisher - NCI Method	92	33.9	14.4	91.8	138.3

3.4 Discussion

[NPT]
The FFQ fish consumption rates presented here are higher than those observed in other Pacific Northwest tribal fish consumption surveys, such as the Columbia River Inter-Tribal Fish Consumption survey (which included the Nez Perce Tribe), with an exception being the survey of the Suquamish Tribe. The NPT's FFQ mean consumption rate is from 50% to 100% larger than the FFQ mean rate of the other tribes in Table S3, except the Suquamish Tribe. The 95th percentile is from 56% to 125% larger than that of the other tribes, excepting the Suquamish Tribe. The NPT's FFQ rates and NCI-method rates are also many-fold higher than the fish consumption rates for the U.S. general population. (See Table S3.)

[NPT]
Table S3. Nez Perce Tribe. Total fish consumption rates of adults in Pacific Northwest Tribes (with consumption rates available) and the U.S. general population. Consumers only.

	No. of		Percentiles	
Population	**Respondents***	**Mean**	**Median**	**95th**
Nez Perce Tribe - FFQ	**451**	**123.4**	**70.5**	**437.4**
Nez Perce Tribe – NCI Method	**451**	**75.0**	**49.5**	**232.1**
Tulalip Tribes (Toy, et al, 1996)	73	82.2	44.5	267.6
Squaxin Island Tribe (Toy, et al, 1996)	117	83.7	44.5	280.2
Suquamish Tribe (The Suquamish Tribe, 2000)	92	213.9	132.1	796.9
Columbia River Tribes (CRITFC, 1994)	464	63.2	40.5	194.0
USA – NCI Method (Polissar, et al, 2014)	9,129	18.4	11.8	57.5

*Consumers only.

This survey has strengths and limitations. One strength is the use of a unique frame for drawing the sample: tribal enrollment records. The use of the enrollment records avoided a costly effort to develop an alternative frame for sampling. The random sampling (as opposed to, for example, a convenience sample) and the adjustment for non-response through statistical weighting are additional strengths. Yet another strength is the presence in the survey team of considerable relevant experience in: survey fieldwork (Pacific Market Research), conducting surveys of other Native American tribes and minority ethnic groups (The Mountain-Whisper-Light and Pacific Market Research), conducting statistical analysis and reporting results of Native American fish consumption surveys (The Mountain-Whisper-Light), and working with Native Americans on environmental issues (Ridolfi). The use of the NCI method (and collection of related data very close to the interview date) is another strength. The NCI method results are probably closer to the true consumption rate distribution for the Tribe, but the FFQ consumption rates are also

plausible. The truth probably lies somewhere in between, though likely closer to the NCI-method rates, which are based on consumption 'yesterday' (24-hour recall) rather than on memory of the preceding year's consumption.

One limitation of the survey is the response rate of 38%. While the statistical weighting may have addressed the potential selection bias that may occur when there is a response rate of this magnitude, it is possible that those in the sample who were not reached and interviewed do have a different consumption rate regimen, on average, than those included. That is an unknown at this time, and the response rate of 38%, by itself, does not discredit this survey. The 95% confidence interval widths presented later in this report allow interpretation of uncertainty in the FCRs presented. The estimated value that the confidence interval brackets is the best statistic to use in in assessing fish consumption rates.

An important lesson learned from this survey experience is that the involvement of the leadership and staff of the Tribe and the incentives financed by the Tribe were critical to the success of this project and should be considered important factors in developing other fish consumption surveys of Native Americans.

[SBT]
The fish consumption rates presented here, and those of the Nez Perce Tribe presented in a companion report, are higher than those observed in other Pacific Northwest tribal fish consumption surveys, except for the survey of the Suquamish Tribe. The SBT's FFQ mean consumption rate is from 89% to 150% larger than the FFQ mean rate of the other tribes in Table S3, except the Suquamish Tribe. The 95th percentile is from 125% to 311% larger than that of the other tribes, except the Suquamish. The SBT's FFQ fish consumption rates are also many-fold higher than fish consumption rates for the U.S. general population.

Table S3. Shoshone-Bannock Tribes. Total fish consumption rates of adults in Pacific Northwest Tribes (with consumption rates available) and the US general population. Consumers only.

	No. of		Percentiles	
Population	**Respondents***	**Mean**	**50th**	**95th**
Shoshone-Bannock Tribes - FFQ	**226**	**158.5**	**74.6**	**603.4**
Shoshone-Bannock Tribes – NCI Method	**226**	**34.9**	**14.9**	**140.9**
Tulalip Tribes (Toy, et al, 1996)	73	82.2	44.5	267.6
Squaxin Island Tribe (Toy, et al, 1996)	117	83.7	44.5	280.2
Suquamish Tribe (The Suquamish Tribe, 2000)	92	213.9	132.1	796.9
Columbia River Tribes (CRITFC, 1994)	464	63.2	40.5	194.0
USA/NCI (Polissar, et al, 2014)	9,129	18.4	11.8	57.5

*Consumers only.

This survey has strengths and limitations. One strength is the use of a unique frame for drawing the sample: tribal enrollment records. The use of the enrollment records avoided a costly effort to develop an alternative frame for sampling. The random sampling (as opposed to, for example, a convenience sample) and the adjustment for non-response through statistical weighting are additional strengths. Yet another strength is the presence in the survey team of considerable relevant experience in: survey fieldwork (Pacific Market Research), conducting surveys of other Native American tribes and minority ethnic groups (The Mountain-Whisper-Light and Pacific Market Research), conducting statistical analysis and reporting results of Native American fish consumption surveys (The Mountain-Whisper-Light), and working with Native Americans on environmental issues (Ridolfi). The use of the NCI method (and collection of related data very recent to the interview date) is another strength. The NCI method results are probably closer to the true consumption rate distribution for the Tribe, but the FFQ consumption rates are also plausible. The truth probably lies somewhere in between, though likely closer to the NCI-method rates.

One limitation of the survey is the response rate of 42%. While the statistical weighting may have addressed the potential selection bias that may occur when there is a response rate of this magnitude, it is possible that those in the sample who were not reached and interviewed do have a different consumption rate regimen, on average, than those included. That is an unknown at this time, and the response rate of 42%, by itself, does not discredit this survey. The 95% confidence interval widths presented later in this report allow interpretation of uncertainty in the FCRs presented. The estimated value that the confidence interval brackets is the best statistic to use in in assessing fish consumption risks.

An important lesson learned from this survey experience is that the involvement of the leadership and staff of the Tribes and the incentives offered to the respondents by the Tribes were critical to the success of this project and should be important factors in developing other fish consumption surveys of Native Americans.

3.5 Conclusion

[NPT]
The Nez Perce Tribe has FFQ fish consumption rates that are among the highest in the Pacific Northwest and both the FFQ and NCI-method means and percentiles are many-fold higher than consumption rates of the U.S. general population (See Table S3.) Fish consumption rates (FCR) determined using the NCI method were lower than those determined using the FFQ approach. Mean FCRs for groups 1 and 2 species, based on the NCI method, were, respectively, 39% and 36% lower than means obtained via the FFQ approach.

[SBT]
The Shoshone-Bannock Tribes have FFQ fish consumption rates that are among the highest in the Pacific Northwest and are many-fold higher than consumption rates of the U.S. general population. (See Table S3.) The high percentile rates from the NCI method are also several-fold higher than the rates for the U.S. general population. Fish consumption rates (FCR) determined using the NCI method were lower than those determined using the FFQ approach. Mean FCRs for groups 1 and 2 species, based on the NCI method, were, respectively, 78% and 83% lower than means obtained via the FFQ approach.

4.0 Introduction

4.1 Background and Purpose

[NPT]
The Native American tribal governments in the State of Idaho have been collaborating with the U.S. Environmental Protection Agency (EPA) Region 10 and other stakeholders to gather data on tribal fish consumption rates (FCR) in Idaho. One objective of this effort is to support the effort to assess risks posed by contaminants in fish for populations who consume fish at high levels. More generally, this effort was intended to enhance tribal environmental capacity in the area of water quality. The tribes worked collaboratively with the State of Idaho in developing tribal surveys that would support Idaho's efforts to develop ambient water quality criteria (AWQC) protective of high fish consumers. This report presents survey methodology and results, specifically FCRs, for the Nez Perce Tribe. The survey is focused on both current and heritage rates.[2]

Water quality is of great importance to the Native American tribes in Idaho, since a substantial portion of their diet consists of fish and shellfish,[3] which may acquire contaminants from water. As the FCRs for populations consuming fish increase, the water must become cleaner in order to keep human exposures to toxic chemicals in fish at acceptable levels. It has been found that Puget Sound and Columbia River tribes have much higher FCRs than the general U.S. population, with consequences for target water quality. EPA Region 10 is supporting Idaho's tribal governments in identifying appropriate FCRs to use in protecting the health of the Idaho tribes. The FCR statistics (i.e., averages and percentiles) included in this report are provided in terms of the grams of uncooked fish and shellfish consumed by a person on a daily basis over the course of a one-year period.

A fish consumption study fits into a larger context, There are three eras of importance for such a study: the past, the present, and the future. Considering the past, over an extended period of time the Nez Perce Tribe has experienced environmental and social changes that have reduced fish abundance, access to fish, safety of fish consumption, and fish consumption itself. The Tribe is seeking to increase fish availability, reduce contamination of fish, and increase fish consumption in the future. Thus, current consumption does not reflect the Tribe's past nor its goals. Assessing consumption through a current cross-sectional survey will provide relatively precise information about current consumption only. For the overall goals of this survey, the current consumption rates should not be considered in isolation. Heritage rates are reported in Volume I of this report. Assessing past consumption through an assessment of historical materials and, potentially, interviews with some older individuals whose history reaches back a long lifetime may be highly informative, but rates so derived are likely not as precise as current survey rates because they involve longer-term recall and unknown quality and completeness of past documentation.

[2] [NPT]Hereafter, "survey" will refer to the survey of current fish consumption of the Nez Perce Tribe, unless the context makes it clear that the heritage rate survey or another survey is being referenced.
[SBT]Hereafter, "survey" will refer to the survey of current fish consumption of the Shoshone-Bannock Tribes, unless the context makes it clear that the heritage rate survey or another survey is being referenced.
[3] Hereafter, "fish" will refer to fish and shellfish.

The heritage rate study fits into this framework as well, as part and parcel of this final report. There have been many studies of historic rates and suppression in the past, but their isolation from a report on current rates may have denied them the attention they deserve.

The rates and supporting materials generated by this study will be used to protect the health of tribal members and other Idaho residents who consume large quantities of fish. The strength of the current rates is that they are derived by a technically defensible methodology, and these rates can be compared to those of other populations. The strength of the heritage rates is their relevance to the goals of the Tribe.

The survey was implemented largely consistent with the final survey design report of the Nez Perce Tribe. Some design modifications were made while the survey was underway to improve response rates without introducing bias.

[SBT]
The Native American tribal governments in the State of Idaho have been collaborating with the U.S. Environmental Protection Agency (EPA) Region 10 and other stakeholders to gather data on tribal fish consumption rates (FCR) in Idaho. One objective of this effort is to support the effort to assess risks posed by contaminants in fish for populations who consume large quantities of fish in the State of Idaho and among the Idaho tribes. More generally, this effort was intended to enhance tribal environmental capacity in the area of water quality. The tribes worked collaboratively with the State of Idaho in developing tribal surveys that would support Idaho's efforts to develop ambient water quality criteria (AWQC) protective of high fish consumers. This report presents survey methodology and results, specifically FCRs, for the Shoshone-Bannock Tribes. The survey is focused on both current and heritage rates.[4]

Water quality is of great importance to the Native American tribes in Idaho, since a substantial portion of their diet consists of fish and shellfish, which may acquire contaminants from water. As the FCRs for populations consuming fish increase, the water must become cleaner in order to keep human exposures to toxic chemicals in fish at acceptable levels. It has been found that Puget Sound and Columbia River tribes have much higher FCRs than the general U.S. population, with consequences for target water quality. EPA Region 10 is supporting Idaho's tribal governments in identifying appropriate FCRs to use in protecting the health of the Idaho tribes. The FCR statistics (i.e., averages and percentiles) included in this report are provided in terms of the grams of uncooked fish and shellfish consumed by a person on a daily basis over the course of a one-year period.

4.2 A Brief Description of the [Shoshone-Bannock Tribes] [Nez Perce Tribe]

[SBT]
The Shoshone-Bannock Tribes of today are a self-governing, Federally Recognized Tribe with reserved off-Reservation Treaty rights secured by the Fort Bridger Treaty of July 3, 1868.The

[4] [NPT]Hereafter, "survey" will refer to the survey of current fish consumption of the Nez Perce Tribe, unless the context makes it clear that the heritage rate survey or another survey is being referenced.
[SBT]Hereafter, "survey" will refer to the survey of current fish consumption of the Shoshone-Bannock Tribes, unless the context makes it clear that the heritage rate survey or another survey is being referenced.

Fort Hall reservation, permanent homeland of the Tribes, is located in Southeastern Idaho near the city of Pocatello. The Snake and Blackfoot rivers provide for the western and northern reservation boundaries and the Portneuf River begins and ends on the reservation. Additional notes on the Tribes are contained in the Tribes' Foreword to this report.

[NPT]
The Nez Perce Tribe of today is a self-governing, Federally Recognized Tribe located on a reservation in north central Idaho which lies primarily in the Camas Prairie region south of the Clearwater River, covering parts of Nez Perce, Lewis, Idaho, and Clearwater Counties. The tribal government seat is at Lapwai, which also contains the largest population of Nez Perce, and the largest community overall within the reservation boundary is the City of Orofino.

Additional material about the Nez Perce Tribe can be found in the document, "Design of a Survey on Fish Consumption by the Nez Perce Tribe," that is located in Appendix E of this report.

4.3 Populations

[NPT]
The tribal populations described quantitatively in this report are the Nez Perce Tribe as a whole and the population of "documented" fishers within the Tribe. Identification of the fisher group was achieved using a list of fishers that was derived from the Nez Perce Department of Fisheries Resources Management (DFRM) records of sampling activities that are conducted annually for certain fisheries. Information is collected and compiled for specific individual tribal members who fish at certain rivers/areas. Tribal members were observed or interviewed for their fishing activities at a certain area during a certain fishery season. This fisher data either was collected during the actual fishery season or collected post-season. This list represents only those tribal members who provided in-season and/or post-season catch/harvest data to DFRM staff. Some tribal members who are, in fact, fishers, do not appear on the fishers list. Thus, the fishers list is not a comprehensive representation of all "fishers" of the Tribe, but, rather, a "fisher indicator" (i.e., includes a subset) of the true fisher population. When the term "fisher" is used in this report, it refers to persons appearing on this fishers list. When there is reference to a non-fisher, it means a person not on the fishers list. A certain fraction of those not on the fishers list do, in fact, harvest fish. Despite any inaccuracies in designation of fishers and non-fishers, the fishers list is a useful roster of persons, most of whom are engaged in fishing and harvesting activities. Those on the fishers list constitute one of the populations identified in this report, with a presentation of their consumption rates.

[SBT]
The tribal populations described quantitatively in this report are the Shoshone-Bannock Tribes as a whole and the population of fishers within the Tribe. The fisher population for this study was taken from a list of tribal members who have attended Tribal Fish and Wildlife Department informational meetings to learn about fish run status and regulation changes and who have submitted their contact information for any future informational outreach opportunities provided by the Tribal Fish and Wildlife Department. The individuals on the fishers list may or may not directly engage in fishing activities, and, similarly, some of those not on the fishers list may, in

fact, be fishers. Thus, the fishers list is not a comprehensive representation of all "fishers" of the Tribes, but rather a "fisher indicator" (i.e., a subset) of the true fisher population plus some fraction of persons who do not fish. When the term "fisher" is used in this report, it refers to persons appearing on this fishers list. When there is reference to a non-fisher, it means a person not on the fishers list, but a certain fraction of those not on the fishers list do, in fact, harvest fish.

4.4 Guide to Report Sections

[BOTH]
This document follows the commonly used IMRD format for scientific articles and reports: **I**ntroduction, **M**ethods, **R**esults and **D**iscussion. After this introduction, the methods used to prepare for and then execute the survey in the field are described, as are the methods used to analyze the data obtained from the survey. The Results section contains demographic statistics about the population, the selected sample and the survey respondents, survey response rates, quantitative fish consumption rates (overall and by demographic subgroups) and other statistics related to tribal fishing and fish consumption. The Discussion section recaps the main findings and discusses the strengths and limitations of the survey and its analysis. Appendices include supporting technical material.

5.0 Methods

5.1 Overview

[BOTH]
This section describes the basis for choosing the survey sample, including sample size, inclusion/exclusion eligibility criteria, and the definition of the geographic area from which survey-eligible tribal members were selected. It discusses the review and approval process, by both tribal and external sources, for determining the survey's approach and procedures.

This section also reviews the development of the questionnaire, the methods used to draw the sample from tribal enrollment records, identification of fishers[5] to be used in calculating fisher consumption rates, allocation of selected tribal members to sample waves of interviewing in order to provide interviewing throughout the one-year survey period, re-interviewing of initial respondents, and the relevance to this survey of computer-assisted personal interviewing.

Selection and training of interviewers is discussed, along with methods for calculating survey response rates, methods for weighting the sample to adjust for differential response rates in different sample strata and for differentials in the probability of response related to demographic factors. Finally, this section covers methods to convert respondent data on frequency and portion sizes of consumed species to quantitative consumption rates, and methods to obtain means and percentiles of fish consumption and their confidence intervals using two different analysis methodologies. One methodology uses data collected from a food frequency questionnaire (FFQ). A separate methodology, the "NCI method," uses data collected from the respondents' recall of fish consumption during a 24-hour period—"yesterday"—but also uses FFQ data as covariates.

5.2 Sample Selection

[BOTH]
The planned sample size was developed to fulfill two goals: (a) a sufficient sample size so that means and percentiles of fish consumption rates calculated from the FFQ portion of the questionnaire would be reasonably precise; and, (b) a sufficient sample size to provide reasonable assurance of an adequate number of respondents with two separate 24-hour recall interviews, both of which reported some fish consumption during the preceding 24-hour day ("yesterday").

The second goal was considerably more challenging to plan than the first. The criterion of at least 50 "double hits" from the survey—two separate, independent interviews wherein a respondent recalled eating fish on the preceding day—is a requirement[6] of one of the methods used to calculate a distribution of usual fish consumption. The "NCI method" refers to a

[5] [BOTH] See section 4.3 for a definition of 'fisher' as used in this document.
[6] While analysis by the NCI method might be possible with fewer than 50 double hits, the 50 count provides reasonable assurance that models used in the analysis will converge on the necessary parameter estimates.

statistical procedure for calculating the distribution of usual consumption of episodically consumed foods (Dodd, KW, et al. 2006; Tooze, JA, et al. 2006; Kipnis V, et al. 2009). Fish consumption would fall into the "episodically consumed" category, since most people do not eat fish every day. This technical method was designed to exploit data collected about consumption (or non-consumption) of a food item on two or more independent days. The NCI method has been used to analyze the data of this survey and the results of the analysis are provided in this final report.

Part of the challenge in planning the sample size was the lack of relevant data or tabulations on frequency of fish consumption (expressed in days with fish consumption per week, days per month, or days per year). Data of this type was needed in order to estimate what percentage of respondents who reported about their fish consumption on two independent days would have fish consumption on both days. A count of 50 of the respondents having these 'double-hits' (two days with fish consumption) is needed to provide strong assurance that the NCI method can provide a distribution of consumption rates for a population. Among the fish consumption survey reports about Native American tribes in the Pacific Northwest, there is no survey that includes tabulations specifically on the frequency of consumption of fish (all species combined), with frequency reported as consumption days per week, per month, per year or per other time unit. The tabulations closest to this framework are in a Columbia River Inter-Tribal Fish Commission (CRITFC) survey report (CRITFC Technical Report 94-3, 1994), which reports on the frequency of fish meals (not days with fish meals).

[NPT]
The CRITFC survey (CRITFC, 1994) was carried out among four Columbia Basin tribes and is applicable to the Nez Perce Tribe who fish, among other areas, in waters located within the State of Idaho. The Nez Perce Tribe's CRITFC survey respondents constituted 19% of the statistical weight used in determining the CRITFC combined-tribe consumption rates, such as means and percentiles of fish consumption[7].

[SBT]
The CRITFC survey was carried out among four Columbia Basin tribes—geographically "in the neighborhood" of the five Idaho tribes which were considering participation in the current survey.

[BOTH]
Some calculations were carried out on the expected number of double hits with various assumed sample sizes, and some assumptions were made which allowed for the conversion of fish meals per week, as tabulated in the CRITFC report, to days with fish meals per week. Using these planning assumptions and the CRITFC input tabular data, it was estimated that a sample of approximately 1,800 tribal members would provide good confidence that those completing the

[7] [NPT only]See CRITFC, 1994, Appendix 1, pages 106-107. The value of 19% statistical weight for the Nez Perce Tribe is the Nez Perce population divided by the total population of all four tribes as listed in the CRITFC report, page 106. The listed population of the four tribes (which determines the statistical weight of each tribe in calculating the combined CRITFC rates) are as follows: Umatilla, 818; Nez Perce, 1440; Warm Springs, 1531; Yakama, 3872. Total of the four tribes: 7661

interviews of the survey would include at least 50 individuals who would report eating fish on both of the two independent days targeted by a 24-hour recall questionnaire (i.e., 50 double hits).

Initially, five tribes of Idaho (the Kootenai, Shoshone Paiute, Coeur d'Alene, Shoshone-Bannock, and Nez Perce) were contemplating participation in the survey during this planning phase. To employ the NCI method for each tribe individually, 50 double hits would have been needed for each tribe. This was not possible given the resources available. Consequently, the 1,800 interviews were to be distributed over the five participating tribes with the intention of finding 50 double hits from the pooled results of all participating tribes. Thus, the authors decided to report separate FCR distributions per participating tribe, using the NCI method, although the data from multiple tribes would need to be pooled as input to the NCI method. The rates for individual tribes would be obtained through the use of covariates in the NCI modeling process. The NCI method includes provisions for the use of covariates (see section 5.23.2), and thus each tribe would receive its own set of rates based on the NCI method.

After further deliberations by the Idaho tribes, the Nez Perce and Shoshone-Bannock Tribes were the tribes who chose to participate in surveying current fish consumption. Based on discussions with staff of these Tribes, the planned approximate sample size of 1,800 was allocated as a sample of approximately 1,200 from the Nez Perce Tribe and 600 from the Shoshone-Bannock Tribes. Based on available information regarding fisheries and harvest levels, it was thought that the Nez Perce Tribe had higher fish consumption rates than the Shoshone-Bannock Tribes. Allocating more interviews to the Nez Perce Tribe improved the chances of obtaining 50 double hits. The two tribes recognized that they both needed to achieve the necessary number of "double hits" and that this part of the survey would require a joint effort to do so.

The anticipated percentage of sampled members providing two 24-hour interviews was calculated as: (a) an anticipated 60% response rate for the first 24-hour interview (and FFQ-based interview), followed by (b) an anticipated 80% response rate for the second interview among those participating in the first interview. The 60% for the first interview response rate was selected as a conservative value given that response rates above 60% have been obtained for other Northwest tribal fish consumption surveys (see Toy, et al, 1996 and Suquamish Tribe, 2000). The 80% continuation rate for those completing the first interview was simply an assumed reasonable value for continuation among those who had participated in the first interview. The net response rate for completion of both interviews would thus be 48%—approximately half of the sampled members.

5.3 Inclusion/Exclusion Criteria

[BOTH]
The survey was designed to assess the consumption rate of adults, defined as individuals age 18 and over. Specifically excluded from the survey were any members who were living in an institutional setting (e.g., a nursing home). The reason for this exclusion is that a person in the institutional setting would typically not be in control of their diet and might not be living a tribal lifestyle in terms of diet. The enrollment files did not indicate this status, and such members were identified during the initial contacts or attempts at contact with potential respondents.

During the interview process, an additional exclusion was incorporated: tribal members who could not participate in the interview process due to physical, mental or other reasons were excluded as they were encountered.

There were no exclusions based on language issues. In advance of the survey, the contractor team was informed by the tribal authorities that there would be no need to prepare for interviews in any other language than English. No instances of non-response due to language issues were reported to the contractors.

5.4 Geographic Sample Selection Criteria

[BOTH]
Initial exploration showed that this survey could not use the entire population of adult tribal members as a target population for interviews. Data (not containing any personally identifying information) from the tribal enrollment office showed that tribal members live throughout the United States, with the greatest concentration on and near the reservation. There would clearly be a limitation on the travel resources available for interviewing people in person; persons living very far from the reservation would need to be excluded. Secondly, there was a concern that members living very far from the reservation and far from the fisheries used by tribal members might be different in some way from those living close; fish consumption habits, lifestyle, and other known or unknown factors might substantially differ from those living closer to or on the reservation. The travel limitations were the deciding factor in limiting the geographic scope of the survey. A fifty-mile travel limit was considered acceptable for practical survey operation. The selection of geographic areas was based on ZIP codes, and the selected ZIP codes for the survey were approved by the Tribe(s). The selected ZIP codes are shown in Table 1 and displayed in Figure 1. Not all zip codes shown in the table and map provided respondents who were interviewed for the fish consumption survey. However, prior to conduct of the survey the noted ZIP codes were eligible, should a respondent residing therein be sampled and interviewed.

[NPT]

Figure 1. Nez Perce Tribe. Nez Perce reservation and surrounding eligible ZIP codes for inclusion in the fish consumption survey.

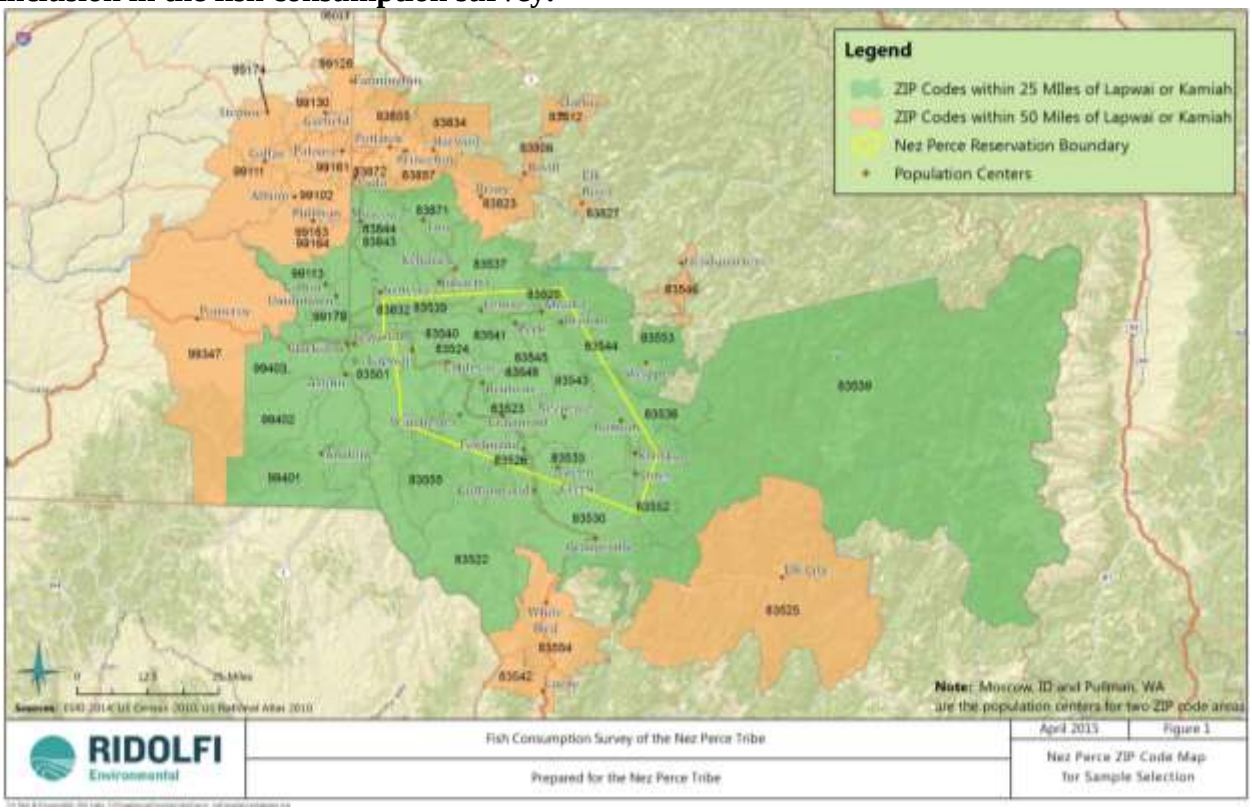

Table 1. Nez Perce Tribe. ZIP codes included for sampling members of the Nez Perce Tribe.

ZIP Code	Population Center
83501	Lewiston
83520	Ahsaka
83522	Cottonwood
83523	Craigmont
83524	Culdesac
83525	Elk City
83526	Ferdinand
83530	Grangeville
83533	Green Creek
83535	Juliaetta
83536	Kamiah
83537	Kendrick
83539	Kooskia
83540	Lapwai
83541	Lenore
83542	Lucile
83543	Nezperce
83544	Orofino
83545	Peck
83546	Headquarters
83548	Reubens
83552	Stites
83553	Weippe
83554	White Bird
83555	Winchester
83806	Bovill
83812	Clarkia
83823	Deary
83827	Elk River
83832	Genesee
83834	Harvard
83843	Moscow
83844	Moscow
83855	Potlatch
83857	Princeton
83871	Troy
83872	Viola
99102	Albion
99111	Colfax
99174	Steptoe
99113	Colton
99128	Farmington
99130	Garfield
99161	Palouse
99163	Pullman
99164	Pullman
99179	Uniontown
99347	Pomeroy
99401	Anatone
99402	Asotin
99403	Clarkston

[SBT]

Figure 1. Shoshone-Bannock Tribes. Fort Hall Reservation and surrounding eligible ZIP codes for inclusion in the Shoshone-Bannock Tribes fish consumption survey.

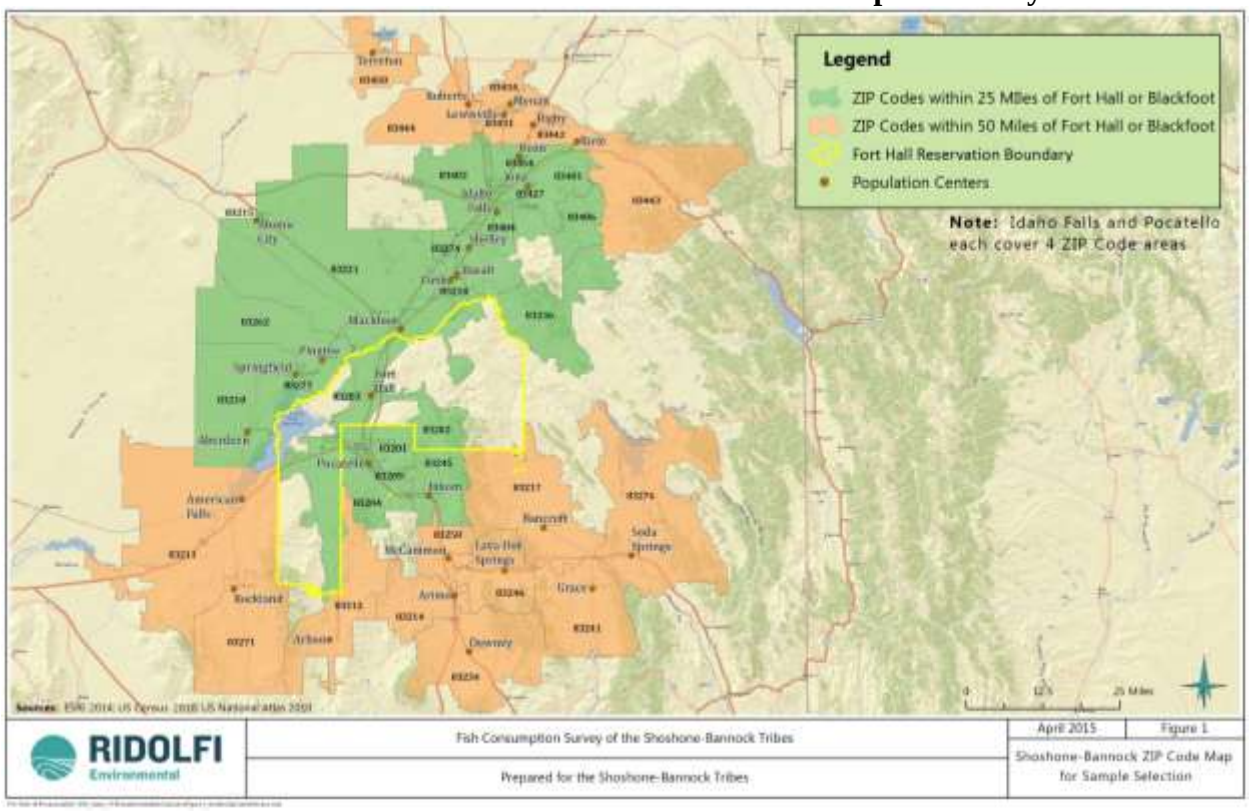

Table 1. Shoshone-Bannock Tribes. ZIP codes included for sampling members of the Shoshone-Bannock Tribes.

ZIP Code	Population Center
83201	Pocatello
83202	Pocatello
83203	Fort Hall
83204	Pocatello
83209	Pocatello
83210	Aberdeen
83211	American Falls
83212	Arbon
83214	Arimo
83215	Atomic City
83217	Bancroft
83218	Basalt
83221	Blackfoot
83234	Downey
83236	Firth
83241	Grace
83245	Inkom
83246	Lava Hot Springs
83250	McCammon
83262	Pingree
83271	Rockland
83274	Shelley
83276	Soda Springs
83277	Springfield
83401	Idaho Falls
83402	Idaho Falls
83404	Idaho Falls
83406	Idaho Falls
83427	Iona
83431	Lewisville
83434	Menan
83442	Rigby
83443	Ririe
83444	Roberts
83450	Terreton
83454	Ucon

5.5 Stratification and Drawing the Sample

[SBT]
The survey statistical team obtained a copy of the tribal enrollment list in Excel format (listing tribal members ages 18 and over) as well as a mailing list for the fishers list. These files were processed for sampling, a stratified random sample of study participants was drawn, and spreadsheets containing participant information were prepared for the interviewers.

The information in the tribal enrollment files included a list of tribal members and, for each, his or her ZIP code, age, and designation as a person on the fishers list. The ZIP code was used to determine eligibility for the study (see Section 5.4). Whenever available, the ZIP code of the physical (residence) address was used to determine eligibility for the study. In a few cases where this information was unavailable, however, the mailing address's ZIP code was used instead.

All tribal members in the file supplied by the enrollment office were 18 years of age or older and thus were eligible for selection into the sample on the basis of age. A total of 3,242 members qualified by their ZIP codes (55 of these by mailing address, as their physical addresses were not available). Each of these 3,242 members was assigned a unique PMRID (Pacific Market Research Identification Number).

Five age groups were established (18–29, 30–39, 40–49, 50–59 and 60+), after which the number of tribal members was cross-tabulated by age group and by residence (either on- or off-reservation). Gender was considered as an additional potential stratification variable, but was not included due to concerns this would lead to very small sample sizes for some strata. The number of participants who would be sampled in each combination of age group and on/off-reservation status (potential strata) were then calculated. As all of the five potential off-reservation strata were small, all were combined into one stratum ("off-reservation"). The on-reservation members were divided into five strata according to age group, yielding a total of six strata for the sample selection. The fishers became a separate stratum later in the process, described below.

Stratified random sampling was performed. The proportion of random samples from each stratum was chosen to be the same proportion as in the eligible population. The total number of tribal members in the initial primary sample was 400. This number was chosen to yield, with an anticipated high probability, at least 325 samples of members who were *not* on the fishers list (assuming 300 eligible members on that list). Additional fishers were subsequently added into the sample, increasing the sample size.

The primary sample was divided into four waves (one per three-month calendar period), and each wave was further divided among four interviewers according to the sampled members' ZIP codes. As more than three-quarters of the members were from the Fort Hall ZIP code (83203), the sample for this ZIP code was randomly divided among three interviewers. The remaining sample (outside of the Fort Hall ZIP code) was assigned to the fourth interviewer. The sample for the fourth interviewer was smaller in count, but required more substantial travel to reach the participants in these more diverse ZIP codes. Subsequently, interviewers were permitted to transfer potential respondents among themselves.

In addition to the random sampling within the six strata described above, all tribal members on the fishers list were selected and merged with the initial primary sample to form the final sample. Members who were on the fishers list and already in the initial primary sample were identified and only included once in the sample. Any member on the fishers list was recorded as being in the fishers stratum, regardless of the original strata to which the member belonged. Thus, all strata were mutually exclusive. The fishers eligible to be included in the fisher sample stratum were identified by a knowledgeable member of the Shoshone-Bannock Tribes staff, relying on the available list of fishers and the staff member's knowledge of the Tribes. (See the "Populations" section of this document for a description of the fishers list used by the staff member.)

All data with personally identifiable information (PII) were protected by password and transferred to a tribal staff member authorized to receive PII. The Mountain-Whisper-Light retained a file with some of the data items that did not include PII.

[NPT]
The survey statistical team visited the Nez Perce Tribe on April 3, 2014 to draw the sample for interviewing, which was carried out on-site in the tribal offices. The Tribe provided the contractors with a tribal enrollment list of 2,729 members. The list contained gender, age, physical address and mailing address for each tribal member (though a physical address was not always available).

Members eligible for sampling were determined by first restricting the list to those 18 years or older and with a physical address ZIP code on the eligible ZIP code list (see Section 5.4.) For records without a physical address, the ZIP code of the mailing address was used instead. For records in which both addresses were available, the ZIP codes of the physical and mailing addresses matched in 2,011 of 2,061 cases, or 98% of them. This close matching supported the use of mailing address ZIP codes as a surrogate for physical address ZIP code when needed. Of the original list of 2,729 members eligible for sampling, two were less than 18 years old, 68 were missing both physical and mailing addresses, and 1,085 were located outside of the eligible ZIP codes, leaving 1,574 eligible for the sample.

Each eligible members was assigned a unique PMRID (Pacific Market Research Identification Number). A stratified random sample size of 1,250 was drawn from the 1,574 eligible members, with strata defined by each combination of gender and age group (18–29, 30–39, 40–49, 50–59, 60+). No other demographic variables were available in the tribal enrollment list. The percentage of each stratum in the population of the 1,574 eligible members was then determined. The sample size allocated per stratum was determined by multiplying 1,250 by the population percentage computed for each stratum, thus creating a stratified sample with strata sizes proportional to the corresponding strata in the original population of interest. The sampled members were then randomly partitioned into four waves (to be successively allocated to interviewers approximately every three months) within each stratum.

Personally identifying information (PII) was utilized to draw the sample, but all such information was left with the Nez Perce Tribe after generating the list of sampled members. The Tribe retained full control of PII and its use for interviewing.

5.6 Questionnaire Development

[BOTH]
The survey team developed an interview questionnaire to gather information from tribal members to help determine current tribal fish consumption rates. Questionnaires from several other surveys were reviewed, specifically other Pacific Northwest regional fish consumption surveys employing a Food Frequency Questionnaire approach (Suquamish 2000, Toy et al. 1996, Sechena et al. 1999, CRITFC 1994). A draft questionnaire drew on components of these questionnaires. After several iterations and refinements, the final Food Frequency Questionnaire (FFQ) became the critical survey instrument used to ask respondents about their dietary patterns and activities related to fish consumption over the preceding 12 months. The questionnaire also covered several other topics. Drawing primarily from U.S. national dietary surveys (NCHS, 2005), additional questions were included in the questionnaire to assess fish consumption during the preceding 24 hours ("yesterday"). These 24-hour recall questions were needed in order to enable use of the NCI method of determining the distribution of usual fish consumption. At least two independent days of fish consumption (or non-consumption) need to be assessed for the NCI method. This requirement was met by conducting two 24-hour dietary recall interviews in addition to the FFQ. An attempt was made to match the first and second interview timing during the seven days of the week so that the two interviews would be either both on a weekday or both on a weekend day. In practice, there was some mixing of weekend and weekdays for the two interviews. This mixture is addressed as part of the NCI method of analysis.

After first contacting potential respondents through a telephone screening process, interviewers administered the first 24-hour dietary recall interview and the FFQ in person to willing participants. The second 24-hour dietary recall interview was intended for telephone administration 1-4 weeks after the first interview, though a longer interval was permitted during the later part of the field work.

Data collected during the interviews included fish species consumed, frequency of consumption and portion size, with additional information gathered about fish parts eaten, preparation methods and special events. Qualitative data were collected regarding both changes in fish consumption patterns as compared to the past and expectations for future consumption in order to provide additional context around the quantitative consumption rates. Demographic information was also collected, such as height and weight (to calculate and check fish consumption rates) and education and income ranges (to determine fish consumption rates for various population groups). A subset of respondents was re-interviewed by telephone, which involved asking a subset of the same questions (from the FFQ) a second time.

The FFQ survey questionnaire is presented in Appendix A. The survey team developed this questionnaire with input from the Tribe(s), the EPA, and the Institutional Review Boards (discussed below in Section 5.16) as well as through pilot testing, during which the interviewers tried out the questionnaire on tribal members and provided feedback to the survey team on any problems with the questionnaire. These pilot interviews were not used in the analysis for this report. The questionnaire was ultimately transferred to a Computer-Assisted Personal Interviewing (CAPI) software program on tablets, as described in Section 5.8, to facilitate more

efficient and accurate reporting during the interviews in comparison to use of a paper questionnaire. The questionnaire was then used to conduct interviews via CAPI, along with other visual instruments such as portion models and species identification photographs, as discussed in Appendix B.

5.7 Portion Models, Photos, Portion-to-Mass Conversions

[BOTH]
To facilitate questionnaire administration during the survey, interviewers used portion model displays and species identification photographs (presented in Appendix B). The survey team selected species and developed these visual representations in collaboration with tribal technical and cultural staff to reflect the appropriateness of the fish species and preparation methods most commonly consumed by tribal members.

To aid in accurate determination of portion sizes, three-dimensional (3-D) and two-dimensional (2-D) model displays were used during the in-person interviews. These models can be broadly grouped into three types: realistic depictions of the part of an organism consumed (e.g., a fillet), measures of volume (e.g., bowls of various volumes), or photos of numbers of organisms consumed. Each interviewer had one full set of models to bring to the interviews. A set of photographs depicting those same models, printed at full scale, were left behind with each respondent after the first interview for use during the follow-up (second 24-hour dietary recall) telephone interview. This allowed respondents to report portion sizes using the same models consistently throughout the survey.

The survey team developed the following portion model displays for this survey, each of which included pre-determined serving sizes (as described in Appendix B):

1. A urethane rubber replica of a cooked whole salmon fillet, cut into multiple servings.
2. A flexible plastic replica of a single-serving, cooked trout-like (white fish) fillet.
3. A gray PVC pipe to represent lamprey, marked with portions sizes.
4. A package of salmon jerky to represent dried (or similarly shaped) fish tissue.
5. A set of measuring bowls for different portions of fish soup or volume of fish tissue.
6. Photograph displays of selected shellfish (crayfish, mussels, and shrimp).

Interviewers displayed portion models to respondents in familiar cooked forms (e.g., baked or dried); however, associated uncooked weights were calculated for application during data analysis. Each portion model had a specific (unique) code attached to it, and a separate table was created to show the volume and/or weight per species corresponding to each portion identified on a display. To maintain interview efficiency, respondents answered the questions in terms of simple portion marks or codes on each display, saving the interviewer from having to refer to a look-up table for the species-specific weight of the noted portion. Mass conversions of each model serving, corrected according to appropriate published moisture loss factors, were tabulated and used following the interviews to analyze the data and determine fish consumption rates. Details of the portion-to-mass calculations are provided in Appendix B.

In addition to the portion models (and the photographs of them which were left with each respondent), each interviewer had a laminated sheet with illustrations or photographs of each species to facilitate identification by the respondents, if necessary, during the interviews. The species identification photographs used to help respondents identify unfamiliar species during the interviews are also provided in Appendix B.

5.8 CAPI (Computer-Assisted Personal Interviewing)

[BOTH]
The survey implementation team explored many modes for data collection. After careful consideration, the team identified Computer-Assisted Personal Interviewing (CAPI) as the most efficient and best data-collection process for this survey.

With a CAPI system, the respondent or interviewer uses a computer to answer survey questions. This is the preferred mode when a questionnaire is long and complex (Groves, Fowler, et al., 2009), such as in this case, when the in-person portion of the first interview (FFQ plus first 24-hour recall) lasted over an hour. This is due to the way that computer-assisted interviewing improves data quality; the computer script increases interviewer efficiency and decreases the likelihood of human error related to skip-pattern problems (i.e. moving to different sections of the survey based on the answers to previous questions) or misprinted questionnaires. Additionally, the CAPI system provides help screens and error checking and messages at the time of input. This ensures that surveys are completely filled out and enhances the accuracy of the entered data, decreasing backend data cleaning and processing tasks. Finally, there is no need to transcribe results.

The survey team selected Confirmit, a globally-recognized leader among online and CAPI software developers, as the CAPI application because it provides both on-demand resources, via Software as a Service (SaaS), and on-premise software, two critical requirements for this project: the survey team used both SaaS and an on-premise product for the interviews. When interviews were conducted in remote locations without internet or telephone access, the on-premise application, loaded on the tablets, was integral to the data collection process, allowing interviewers to conduct interviews and data entry, then synchronizing their data files the next time their tablets were connected to Wi-Fi.

After the questionnaire was finalized, a programming team built and scripted the computer version (to be used by the interviewers) within the Confirmit environment. This task, including thousands of lines of code, was substantial and was reviewed on a daily basis during the initial programming. All programming reviews were conducted by a programmer who was not directly involved in this project. After the programmed version was approved by the Lead Programmer and vetted by the programming review team, it was delivered to the Quality Assurance Department and the Project Manager for independent review and validation, prior to distribution to a larger team.

Each interviewer received a Windows 8 tablet for this study. These tablets were selected based on their reliability, durability, and especially their small and unobtrusive form factor. Not only

was it important that the tablets were easily portable, but also that the technological "footprint" and the sometimes off-putting nature of a physical barrier between the interviewer and the respondent were minimized.

Interviewers brought the tablets with them to each in-person interview where the interviewer, not the respondent, would enter all data on them. The tablets included detachable screens and keyboards, as well as touchpad mice and power adapters for AC outlets and car lighters—a necessity in some rural areas where power was not always guaranteed.

The tablets were password-protected, and all data files were automatically removed from the tablets after synchronization with the master database. No personally identifiable information from respondents was stored either on the tablets or in the master database.

Data in the master database was exported for data analysis in a standard SPSS file format (IBM SPSS Statistics, Armonk, NY). This data format was readable by the statistical software used (section 5.31). The data set contains a row for each respondent or attempted contact and has a unique ID. Responses to each question in the question are stored in columns. The testing of CAPI and that data input matches the output is described in the next section.

5.9 Interviewer Recruitment and Training, Pilot Tests

[BOTH]
In February 2014, prior to the start of data collection, a widespread recruitment campaign was initiated to search for local candidates to hire as interviewers. The contractors worked closely with the Tribe/Tribes to publicize the survey effort, advertising online, in the newspaper, on tribal bulletin boards, and using word-of-mouth among the tribal council and the fisheries and water quality personnel.

Interviewers were required to be *current* enrolled members of the Tribe/Tribes.

Applicants were screened on paper and over the telephone. Following a successful initial vetting, acceptable candidates were interviewed in person. After these in-person job interviews, non-qualified candidates were culled and a short list of candidates was provided to the tribal council for review and approval. As a professional courtesy, the Tribe/Tribes had "first right of refusal." Candidates who passed the screening process, the in-person interview, and tribal approval were offered year-long positions on the project.

After hiring, the contractors conducted an extensive training and mentoring process. The initial training was a full-day session during which interviewers were presented with the background of the survey, its purpose, and the development of the questionnaire. The interviewers were also taught about the project objectives. The contractors briefed the interviewers on the history of survey research, the guidelines and principles of in-person and telephone interviews, and the Belmont Report (a document which explains the importance of human subject protections). The interviewers were also trained to use the technology associated with the survey as well as the various display models.

Interviewers were taught how to properly screen respondents, how to conduct in-person interviews, and how to conduct telephone interviews. It was explained to them that the first (typically hour-long) interviews would be conducted in person while the second (20-minute or less) follow-up interviews would be administered over the phone. The interviewers were taught how to read all questions verbatim without influencing the respondents' answers. They were also taught how to record all answers exactly as presented to them. The contractors stressed the importance of maintaining objectivity throughout the entire process, from respondent recruitment and screening through the final question of the second interview. There was also instruction and an emphasis on careful and accurate key entry of interview responses into the correct fields in the CAPI tablets.

The final part of the training included mock interviews with the interviewers and trainers. The mock interviews required the use of the tablets, interviewing software, and fish models and photographs. Interviewers were required to complete a mock hour-long interview as well as a mock follow-up telephone interview before completion of their training.

After the initial, day-long training session, interviewers were required to conduct practice interviews, either with family and friends or independently. In this way, they familiarized themselves with the questionnaire, the computer tablet and the CAPI software. After these practice interviews, the survey team contacted each interviewer to solicit feedback. The contractors evaluated the data entered to ensure that the interviewers completed the fields appropriately. Next, the survey team provided "dummy" responses to the interviewers, giving them paper questionnaires with pre-populated data, as well as in-person meetings with a member of the survey team who behaved as a sample respondent. The survey team member answered with the same dummy data.. The dummy data was entered in May 2014.

In June 2014, the Project Manager at Pacific Market Research checked all dummy data entered against the master file, a key version of the dummy data. If discrepancies were found between the key and the data entry by any interviewer, that interviewer was notified and required to correct the errors. Any interviewers who made such errors were required to conduct additional data entry exercises prior to receiving authorization to "go live."

All of the dummy data output was double-checked to make sure that the values entered in the CAPI system matched the values produced by the CAPI system. Concurrent with successful testing, the live interviews with tribal members began. The first live interview was completed on May [NPT] 10, [SBT] 20, 2014 and the last in-person interview included in this report was completed on April [NPT] 24, [SBT] 26, 2015. Telephone interviews continued through May [NPT] 4, [SBT] 3, 2015 to complete the second 24-hour dietary recall.

5.10 Calculation of FFQ Consumption Rates

[BOTH]
Annual consumption rates, which included consumption at special events and gatherings, was computed based on responses to the FFQ portion of the first interview. Respondents described their consumption using portion models to indicate portion size and portion frequency (e.g., once

per week or two times per month). For each species separately, respondents were permitted to describe their consumption in two ways: over the whole year using a single portion size and frequency (constant throughout the year) or over two different periods of higher and lower fish consumption, which may or may not correspond to when the specific species was in season and out of season, respectively. In the case of consumption varying between a high and a low season, respondents would provide portion size and frequency for each of the two periods separately, as well as the duration of the higher consumption period in days, weeks, or months. The low consumption season was then calculated as one year minus the fraction-of-a-year duration of the high consumption season. Stated again for clarity, the duration of high and low seasons (or designation of only one regimen of portion size and frequency throughout the entire year) was reported per each individual species consumed.

Note that the higher consumption period duration was entirely up to the respondent to provide for each species as he or she wished and was also optional if the respondent preferred to mentally average over the whole year rather than two periods; or if a single period was a better approximation to the respondent's consumption pattern than two periods. For the two-period responses, the duration of the higher consumption period provided by the respondent may have been shorter than the biological season of the species or the period may have been longer, for example by preserving fish caught in season and consuming it over an extended period. Most responses ([NPT] 80% of the 2,810 per-species responses from all respondents combined [SBT] 87% of the 1,769 per species responses from all respondents combined) were provided using a single, one-year period rather than a pair of higher and lower consumption periods.

The FFQ asked separately about consumption at and outside of special events and gatherings. The total consumption rate in grams/day (*Rate_Total* in the equations here) was calculated as the sum of the rate which excluded special events and gatherings (*Rate_Nonevents*) and the rate for special events and gatherings only (*Rate_Events*). *Rate_Nonevents* was calculated either based on consumption information provided to represent an entire year as a single period, (*Rate_Nonevents_Whole*) or by combining annualized rates of consumption during a higher consumption period (*Rate_Nonevents_Higher*) and the consumption rate in the remaining lower period (*Rate_Nonevents_Lower*). Each of these rates were calculated per species first, then species-specific rates were summed together to produce species-group rates (see Section 5.11 for definitions of species groups).

If the respondent reported consumption over the whole year as a single period (rather than varying during the year), the consumption rate was determined by the following equation:

$$Rate\_Nonevents\_Whole = SIZE \times FREQ, \quad (1)$$

where *SIZE* = total grams consumed on an occasion when the species was consumed (which quantity is determined based on the portion model used by the respondent, the portion-to-mass conversion factor for the combination of the portion model and species, and the number of portion units consumed) and where *FREQ* = number of portions consumed per day, which may be converted to a daily amount from the number of portions reported per week, per month or per year. Any frequency per week was converted to frequency per day using 7 days/week. Any frequency per month was converted to frequency per day by dividing by the factor 365/12

days/month. Any frequency per year was converted to frequency per day by dividing by the factor 365 days/year. Of note, the year preceding any interview in the survey did not overlap a leap year.

If the respondent reported consumption over two periods (higher and lower consumption), the rates (non-annualized) for each period were computed in the same way as equation (1), above. The two rates were then annualized and combined using the following equation:

$$Rate\_Nonevents = \%HIGH \times Rate\_Nonevents\_Higher + \%LOW \times Rate\_Nonevents\_Lower, \quad (2)$$

where *%HIGH* = the length of the higher consumption period expressed as a proportion of the year; *%LOW* = the length of the lower consumption period expressed as a proportion of the year (*%HIGH* + *%LOW* = 1); *Rate_Nonevents_Higher* = consumption rate in g/day during the higher consumption period; and *Rate_Nonevents_Lower* = consumption rate in g/day during the lower consumption period. The higher-period duration was reported in either weeks or months. Weeks' duration of a high-consumption season were converted to a proportion of a year by multiplying by the factor 7/365. Months' duration of a season were converted to a proportion of a year by multiplying by the factor 1/12.

For special events and gatherings, the only specific species the respondent was asked about were suckers and whitefish (as a single group), salmon (all species combined), resident trout (all species combined) and sturgeon. This approach was based on the fact that a more limited set of species were consumed at special events as well as a desire to reduce respondent burden. For each of these four species/groups, the corresponding consumption rate was computed as

$$Rate\_Events = EFREQ \times \%EVENTS \times SIZE \times FREQ, \quad (3)$$

where *EFREQ* = number of events per day (converted from the number of events per week, month, or year); *%EVENTS* = proportion of events where the given species is consumed; SIZE = total grams of portion consumed, which is determined based on the model used by the respondent, the portion-to-mass conversion factors, and the number of units consumed (multiplicative factor); and *FREQ* = number of portions consumed per day (which may be converted from the number of portions per week, month, or year, as for *Rate_Nonevents*).

The final individual consumption rate (g/day), which also includes consumption both at and outside of special events and gatherings, is determined using the following equation:

$$Rate\_Total = Rate\_Nonevents + Rate\_Events. \quad (4)$$

As *Rate_Nonevents* was calculated for each individual species (e.g. chinook, coho or sockeye salmon) while *Rate_Events* was calculated at the group level (e.g. all salmon), *Rate_Nonevents* in equation (4) was first aggregated to the group level by summing individual species rates as appropriate before the summation with *Rate_Events*.

5.11 Species Groups

[NPT]
The species groups included in this report were determined jointly by the Nez Perce Tribe[8] and EPA staff. EPA staff provided guidance on EPA policy options for developing FCRs that are relevant for ambient water quality criteria to protect human health.

The Nez Perce Tribe decided that from a water quality standard development perspective the appropriate grouping of fish to focus on in this report should include near coastal, estuarine, freshwater and, in particular, anadromous species (Group 2). Inclusion of anadromous species in the FCR used to develop AWQC is a policy option that EPA has made available to states and tribes (US EPA, 2013). In Oregon, anadromous species are included in the FCR used for that state's AWQC (Oregon DEQ, 2011). Anadromous species are also currently included in the FCR used for Washington's proposed AWQC (Washington DOE, 2015). The Nez Perce Tribe wished to report on total fish consumption (Group 1).

Table 2. Nez Perce Tribe. Species groups.

Species Group	Description	Species and Groups Included
Group 1	All finfish and shellfish	All group 2 species, marine finfish (cod, halibut, pollock, tuna, herring, sardines, mackerel, mahi mahi, orange roughy, red snapper, seabass, hamachi, kipper and shark) and other marine shellfish (lobster, crab and shrimp)
Group 2	Near coastal, estuarine, freshwater and anadromous	All species in groups 3, 4 and 5; lobster, crab, shrimp, octopus, oysters, geoduck, razor clam, bay mussel, scallops, and other marine clams or mussels
Group 3	Salmon or steelhead	Chinook, coho, sockeye, kokanee, steelhead, chum, pink, Atlantic and any unspecified salmon species
Group 4	Resident trout	Rainbow, cutthroat, cutbow, bull, brook, lake, brown, bottoms, golden and any unspecified trout species.
Group 5	Other freshwater finfish or shellfish	Lamprey, sturgeon, whitefish, sucker, bass, bluegill, carp, catfish, crappie, sunfish, tilapia, walleye, yellow perch, crayfish, freshwater clams or mussels and any unspecified freshwater species
Group 6	Marine finfish or shellfish	Marine finfish (cod, halibut, pollock, tuna, herring, sardines, mackerel, mahi mahi, orange roughy, red snapper, seabass, kipper, wahoo, yellowtail and shark), marine shellfish (lobster, crab, shrimp, octopus, squid, oysters, geoduck, razor clam, bay mussel, scallops, and other marine clams or mussels) and any unspecified marine finfish or shellfish
Group 7	Unspecified finfish or shellfish	Any response where the species was specified sufficiently to be placed into groups 3, 4, 5 or 6

Note: Group 2 used in this report has been revised from the Group 2 species list presented in a draft interim report of this survey. Species selection for group 2, as presented in this report, was informed in part by the habitat proportions listed per species in U.S. EPA, 2014, Table 1.

[8] Email from Joe Oatman to Nayak Polissar (and others) on June 26, 2015, conveying an email from Marlene Trumbo documenting the Nez Perce Tribal Executive Committee (NPTEC) decision on species groups to be reported.

[SBT]
The fish groupings for which FCRs are reported were approved by the Shoshone-Bannock Tribes. To inform this decision, the EPA provided the Tribes with background on the EPA's approaches for selecting fish groupings for FCRs used to compute AWQC, as described below.

The Shoshone-Bannock Tribes decided that from a water quality standard development perspective the appropriate grouping of fish to focus on in this report should include near coastal, estuarine, freshwater, and in particular, anadromous species (Group 2). Inclusion of anadromous species in the FCR used to develop AWQC is a policy option that EPA has made available to states and tribes (US EPA, 2013). In Oregon, anadromous species are included in the FCR used for that state's AWQC (Oregon DEQ, 2011). Anadromous species are also currently included in the FCR used for Washington's proposed AWQC (Washington DOE, 2015). For informational purposes, the Shoshone-Bannock Tribes wished to report on total fish consumption (Group 1).

Table 2. Shoshone-Bannock Tribes. Species groups.

Species Group	Description	Species and Groups Included
Group 1	All finfish and shellfish	All group 2 species, marine finfish (cod, halibut, pollock, tuna, herring, sardines, mackerel, mahi mahi, orange roughy, red snapper, seabass, hamachi, kipper and shark) and other marine shellfish (lobster, crab and shrimp)
Group 2	Near coastal, estuarine, freshwater and anadromous	All species in groups 3, 4 and 5; lobster, crab, shrimp, octopus, oysters, geoduck, razor clam, bay mussel, scallops, and other marine clams or mussels
Group 3	Salmon or steelhead	Chinook, coho, sockeye, kokanee, steelhead, chum, pink, Atlantic and any unspecified salmon species
Group 4	Resident trout	Rainbow, cutthroat, cutbow, bull, brook, lake, brown, bottoms, golden and any unspecified trout species.
Group 5	Other freshwater finfish or shellfish	Lamprey, sturgeon, whitefish, sucker, bass, bluegill, carp, catfish, crappie, sunfish, tilapia, walleye, yellow perch, crayfish, freshwater clams or mussels and any unspecified freshwater species
Group 6	Marine finfish or shellfish	Marine finfish (cod, halibut, pollock, tuna, herring, sardines, mackerel, mahi mahi, orange roughy, red snapper, seabass, kipper, wahoo, yellowtail and shark), marine shellfish (lobster, crab, shrimp, octopus, squid, oysters, geoduck, razor clam, bay mussel, scallops, and other marine clams or mussels) and any unspecified marine finfish or shellfish
Group 7	Unspecified finfish or shellfish	Any response where the species was specified sufficiently to be placed into groups 3, 4, 5 or 6

Note: Group 2 used in this report has been revised from the Group 2 species list presented in a draft interim report of this survey. The species included in Group 2 in this report were guided in part by the habitat proportions listed by species in U.S. EPA, 2014, Table 1.

5.12 Demographic Groups

[NPT]
Group 1 (all fish) consumption rates were computed by population demographic groups defined by variables available from the enrollment file and the questionnaire. The enrollment file groups were based on gender, age, and whether or not the respondent was a documented fisher as determined from the Nez Perce Tribe fishers list (see footnote 12 on page 71). The questionnaire groups were based on whether the respondent lived on- or off-reservation, the number of persons resident in the respondent's household, and the respondent's education and income levels.

[SBT]
Group 1 (all fish) consumption rates were computed by population demographic groups defined by variables available from the enrollment file and the questionnaire. The enrollment file groups were based on gender, age, whether respondent was a documented fisher (see definition of the fishers list in section 3.2), and whether the respondent lived on- or off-reservation. The questionnaire groups were based on the number of persons resident in the respondent's household, and the respondent's education and income levels.

5.13 Response Rates

[BOTH]
Response rates were calculated according to standard definitions of response rate (AAPOR, 2011). The following specific form of the response rate was calculated**:**

$$RR1 = I / [(I + P) + (R + NC + O) + U]$$

where:
I = The number of complete interviews
P = The number of partial interviews
R = The number of refusals and break-offs
NC = The number of eligible sampled members not contacted
O = The number of other eligible non-respondents
U = The number of non-respondents with unknown eligibility

The use of the RR1 equation is equivalent to the following formulation:

$$RR1 = I / (N – X)$$

where N = the size of the originally selected sample and X = the number of members found to be ineligible after contacting or attempting contact. A completed interview, which contributes to the numerator of the response rate calculation, was defined as one where the respondent either: 1) responded to the screening interview or the FFQ items sufficiently to be classified as a non-consumer (Q3-Q6 of the questionnaire), or 2) completed the full first interview (after the screening interview) with the FFQ items completed and provided enough information to support calculation of an FFQ consumption rate. To satisfy the second condition, a respondent did not need to answer every question but needed to reach the end of the questionnaire. Note that this definitions allows for there to be respondents who sufficiently answered the screening interview

to be classified as consumers (Q3-Q6) but who did not go on to complete the full interview. This means that the number of known consumers in the survey is higher than the number of respondents with known FFQ consumption rates.

An ineligible member, who reduces the denominator of the response rate calculation, was defined as a sampled member who was: 1) found to live outside of the eligible zip codes, 2) found to be employed as a Tribal interviewer involved in the survey, or 3) deceased, institutionalized or impaired. The term "institutionalized" included prospective adult respondents who, at the time of the survey, lived in a setting where they had little or no control over their diets. For example, residents of long-term care facilities, hospice (not in-home), and prison would be classified as institutionalized.

Not all sampled members were contacted, and therefore the eligibility or ineligibility of each sample member could not be determined. This measure of response rate is thus conservative in the sense that its value is reduced by the presence of sampled members who are ineligible but presently unknown to be ineligible. Ineligible members whose ineligibility was unknown to the survey team would include, for example, deceased members whose enrollment records had not yet been updated or members who recently moved out of the eligible zip code area and whose residence address differed from the address of record at the time the enrollment files were used to draw the sample.

5.14 Design Changes

[NPT]
As the survey progressed, a number of issues became evident. It was found that the contact information found in tribal enrollment records was not as accurate as had been hoped, requiring research to locate potential respondents. The time required for interviewers to travel to respondents' homes and conduct interviews was also much greater than expected, and there was some difficulty in conducting interviews at tribal members' homes. Finally, the fraction of individuals agreeing to be interviewed was also lower than expected. All of these factors led to a lower-than-expected rate of interview acquisition and concerns about attaining an appropriate number of interviews.

To address these issues, several design changes were adopted part way through the interviewing period to increase the number of interviews completed and improve the chances of meeting the sample size goals for the NCI method. The first of these design changes was to permit the interviewers to attend special events[9] (e.g., tribal meetings and powwows) and recruit attendees for interviews during the event, drawing potential respondents only from the list of tribal members selected into the sample. As part of this design change, interviewers were permitted to draw respondents from any of the four sample waves of members.

[9] [NPT]The Nez Perce culture and traditional practices involve regular and time-specific ceremonies. Today, these "special events" identified here are a continuation of tribal customs and cultural practices, and provide an opportunity to maintain those traditional values and teachings. These gatherings often have a large attendance, and such occasions served as an opportunity to make contacts and complete interviews.

As part of their activity at these events, the interviewers were also permitted to schedule interviews at a later time (after the special event). Thus, the special events provided an opportunity not only for on-site interviewing, but also to arrange additional interviews later on. After the special event, the criteria reverted to respondent recruitment only from the wave of members assigned to the specific calendar period. However, interviewers were also permitted to conduct interviews (from the sample list, any wave) of members whom they might encounter by chance.

The design change noted above was expected to, and did, greatly increase the acquisition of completed interviews. Any adult willing to be interviewed at a special event was likely part of the sample roster, as approximately 80% of the eligible adults in the Tribe were included in the sample.

The second change was increased coordination in scheduling of interviews. The interviewers' supervisor (from the contractor team) worked more closely with the interviewers to assist them in arranging interviews.

A third design change occurred after the EPA and the contractor team recommended and received approval by the Tribe to expand the interview team to include non-Nez Perce interviewers. Non-Nez Perce interviewers from the EPA and tribal organizations were permitted to assist the Nez Perce interview team. These individuals received the same training and instructions that the Nez Perce interview team received. The non-Nez Perce interviewers were permitted, again, to draw respondents from any wave of members. Non-tribal interviewers visited the Tribe in December, 2014 and March and April, 2015 and interviewed eligible members from the sample list that were tribal government employees. The interviews by the non-tribal interviewers were conducted in the respondents' offices, not in respondent homes. Tribal employees were offered paid time off, by the Tribe, to participate in the survey. In rare cases, the interviewing supervisor, a non-Tribal member, scheduled or completed interviews with Tribal members who were not also Tribal employees, but these instances were rare, and all were pre-approved by the Nez Perce Tribe. Nearly all first contacts with prospective respondents were made by Tribal interviewers. While non-tribal interviewers assisted in interviewing some of the easier-to-contact tribal members (i.e. employees whose work phones and work addresses were known), tribal interviewers were freed up to pursue many more of the hard-to-reach respondents, people who a non-tribal interviewer would have difficulty finding, contacting and convincing to complete the interview. The scope of work for the non-tribal interviewers was limited but their overall efforts were crucial to the success of the project.

[SBT]
No design changes were instituted in the survey. The same methodology was followed throughout. The identification of fishers by using the fishers list maintained by the Tribes (see Section 3.2) was carried out very near the beginning of interviewing. The fishers were established as a distinct stratum (with 100% of fishers included in the sample) virtually at the start of the fieldwork. Note that though fishers are over-represented in the sample (by design), they are not over-represented in the calculated consumption rates (means, percentiles, etc.), due

to the use of appropriate statistical weighting when consumption rates (and other statistics) are calculated.

5.15 Re-Interviews

[BOTH]
A sample of respondents who completed the first interview were sampled to be re-interviewed using a short list of questions related to fish consumption. The goal of the re-interview was to compare the original and re-interview responses to assess reproducibility.

The re-interview questionnaire is contained in Appendix A. The questions cover the frequency of consumption of Chinook salmon, the species with the largest number of consumers among the survey respondents. Additional species were not asked about to limit the total burden on respondents and the duration of the re-interviews. Additional questions in the re-interview cover changes in overall fish consumption and the number of people living in the respondent's household. Responses to corresponding questions in the original and re-interview were compared descriptively using means, standard deviations and Spearman's correlation coefficient.

[NPT]The re-interviews were conducted between April 3 and June 12, 2015 by the Pacific Market Research interview supervisor, a non-tribal interviewer. [SBT] The re-interviews were conducted between March 31 and May 19, 2015 by the Pacific Market Research interviewer supervisor, a non-tribal interviewer. [BOTH] The survey statistical team provided the interviewer with a list of respondents who were originally interviewed within the last 2 month to help select respondents. The list was refreshed every two or three weeks with recent interviews. To help ensure a balanced sample, the list was partitioned into 6 groups, defined by gender and Chinook consumption. For each gender, Chinook consumption was divided into three equal-sized groups using tertiles. The target was 30 re-interviews total, with 5 from each group. The interviewer was aware of the groups but was not aware that the groups were defined by previously reported consumption levels. The interviewer was instructed to carry out re-interviews from each group (e.g., high-consumption females) until five re-interviews in the group were completed.

[NPT]
Over the course of 2 months, 81 respondents were identified for possible contact for a re-interview, of which 67 (83%) had at least one contact attempt. (There was no requirement to contact or attempt to contact all respondents on the list.) Thirty-one re-interviews were completed. The target was 30 but an extra interview was performed (and used in the re-interview analysis), because—on the first interview—one respondent did not provide a complete response regarding Chinook consumption (the duration of the high consumption period was missing), necessitating imputation. The imputed value was retained for comparison to the re-interview value, since such imputations have been used to present the results of this survey. Of the 36 respondents with a re-interview attempt but no completion, there were no (zero) refusals, 22 respondents did not have a valid phone number recorded, five did not respond before the maximum number of contact attempts was reached and 9 had 1-6 contact attempts (median: 2)

before the re-interview quota was reached and no further attempts for these respondents was needed.

[SBT]
Over the course of 2 months, 77 respondents were identified for possible contact for a re-interview, of which 44 (57%) had at least one contact attempt. (There was no requirement to contact or attempt to contact all respondents on the list.) Thirty re-interviewers were completed. Of the 14 re-interviews attempted but not completed, one respondent refused to participate, five did not have a valid phone number recorded, six had a single attempt before the re-interview quota was reached and two had two attempts before the re-interview quota was reached. When the re-interview quota for each group was reached, no further contact attempts were needed.

5.16 Reviews and Approvals

[NPT]
The survey team developed a Survey Design Report in 2014 in collaboration with the Nez Perce Tribe and the EPA that outlined the approach and procedures for implementing the fish consumption survey. In order to meet accepted standards of protection for survey respondents, the Survey Design Report was submitted for review and approval to two Institutional Review Boards (IRBs) and the EPA Human Subjects Research Review Official (HSRRO), the latter of which has the final authority for all human subjects research supported by the EPA.

First, the Northwest Indian College (NWIC) IRB reviewed the design protocol, suggested modifications to the survey questionnaire to ensure protection of tribal respondents, and gave "consultative approval" for the survey to proceed on March 14, 2014. The design team felt that it was important to include an IRB associated with Native American tribes in order to fully assess any issues the research might pose for unique Native American cultures. Subsequently, Quorum Review IRB reviewed the design protocol, including revisions made according to the NWIC IRB recommendations, and issued a "notice of exemption determination" on March 26, 2014 acknowledging that the survey met the criteria for protection of human subjects' personally identifiable information and did not require further review or restrictions. Quorum IRB was the official IRB on record for the survey, since the NWIC IRB played a consultative role. Finally, the EPA HSRRO reviewed the design protocol and supporting documentation, including the IRB letters, and approved the survey design. Ultimately, the Nez Perce Tribe gave final approval for the survey to proceed.

The survey was implemented largely consistent with the methods as described in the final survey design document. Some modifications to the design—in a manner that would not bias the survey—were implemented during the field work to increase the response rate.

[SBT]
The survey team developed a Survey Design Report in 2014 in collaboration with the Shoshone-Bannock Tribes and the EPA that outlined the approach and procedures for implementing the fish consumption survey. In order to meet accepted standards of protection for survey respondents, the Survey Design Report was submitted for review and approval to two

Institutional Review Boards (IRBs) and the EPA Human Subjects Research Review Official (HSRRO), the latter of which has the final authority for all human subjects research supported by the EPA.

First, the Northwest Indian College (NWIC) IRB reviewed the design protocol, suggested modifications to the survey questionnaire to ensure protection of tribal respondents, and gave "consultative approval" for the survey to proceed on March 14, 2014. Subsequently, Quorum Review IRB (the official IRB on record) reviewed the design protocol, including revisions made according to the NWIC IRB recommendations, and issued a "notice of exemption determination" on March 26, 2014 acknowledging that the survey met the criteria for protection of human subjects' personally identifiable information and did not require further review or restrictions. The design team felt that it was important to include an IRB with Native American associations in order to fully assess any issues the research might pose for unique Native American cultures. Finally, the EPA HSRRO reviewed the design protocol and supporting documentation, including the IRB letters, and approved the survey design. Ultimately, the Shoshone-Bannock Tribes gave final approval for the survey to proceed.

[This is a placeholder for a description of the peer review process and results. The content of this section will be provided following completion of the peer review.]

5.17 Internal Reviews

5.17.1 Review by the Tribe(s) and Other Organizations

[BOTH]
A design report containing planned procedures was prepared for review by the Tribe(s), as well as by two affiliated tribal organizations (Columbia River Inter-Tribal Fish Commission—CRITFC—and the Upper Snake River Tribes Foundation—USRTF), the EPA, SRA (the contracting organization managing multiple related contracts for the EPA), and Ross Strategic. These Tribe(s) and organizations provided feedback or approval, and their suggestions were addressed or considered in preparation of a final design document.

A draft interim report was provided to and was reviewed by the two Tribes participating in the current fish consumption survey—the Nez Perce and Shoshone-Bannock Tribes. The report was also provided to and reviewed by the CRITFC and USRTF tribal organizations, as well as the EPA and two organizations closely involved in the work effort: SRA and Ross Strategic. The feedback from these reviews played a role in the released version of the draft interim report, and the benefit of those reviews have carried forward into the current analysis and report.

5.17.2 Review of Statistical Computing

[BOTH]
Two statisticians separately implemented the calculation of the fish consumption rates per respondent, for all species combined (total consumption rate), all reported species groups (see Section 5.11) and also for each of the 45 pre-specified species and species group used in the survey questionnaire. The calculations include the consumption rate formulas described in Section 5.10 and the imputation of missing values as described in Section 5.28. All of these consumption rate values were compared between the two statisticians' implementations of the rate calculation methodology. Any differences found were discussed (without comparing codes), after which each statistician modified their code independently until there was complete agreement for all respondents and all species.

5.18 Overview of Statistical Analysis

[BOTH]
The description of the statistical analysis methods in the following sections is extensive and covers a number of topics, including:

- definition of fish consumers vs. non-consumers (which may vary across the more frequently to less frequently consumed species groups);
- handling of missing values in the FFQ responses about consumption—a methodology which avoided excluding some respondents' consumption records, which were nearly but not entirely complete;
- sampling probabilities and their adjustment for non-response for use in statistical weighting with the intent of providing estimates for the target tribal population;
- evaluation of the impact of [NPT] design changes, including interviewing at special events and non-tribal interviewers, as well as [Both] home vs. non-home interviews;
- confidence interval calculations based on the non-parametric bootstrap using replicate weights, which provided robust estimates of the precision of consumption rate means and percentiles; and
- the NCI method, a complex and flexible modeling approach that was applied to the 24-hour recall responses to estimate consumption rate distributions—in addition to those provided from the FFQ data on estimated consumption over the preceding year

5.19 Sampling Probabilities

[BOTH]
The sampling probabilities (or sampling fraction) for each stratum were calculated as the number of the sampled tribal members in a stratum divided by the number of tribal members in the same stratum. Section 5.20 describes how the sampling probabilities were modified to produce statistical weights used in calculating most results presented in this report.

5.20 Non-Response Adjustments to Weights

[BOTH]
Completed interviews with useable responses for consumption rate calculations (or with a determination that the respondents never consumed fish) were not available for all sampled tribal members. If it could be assumed that non-response to the survey was completely random—for example, not dependent on sampled members' gender, age or other characteristic—then the original sampling weights (based on strata only) could be used without leading to any bias. However, that assumption is often not valid and was not made here. The sampling weights were therefore adjusted for non-response using characteristics available from the enrollment file and fisher indicator list.

The non-response adjustment is used to adjust the probability of being sampled from the tribal population—the "sampling probability." The sampling probability is a quantity used in creating appropriate statistical weights. It is adjusted by taking account of the probability of responding to the survey. That probability of survey response, in turn, is calculated in relation to demographics of the sampled tribal members. The goal is to adjust for potential bias due to differences among responders and non-responders and yield better (usually less biased) estimates of the population value of a statistic, such as a mean. A respondent's sampling weight W (used for statistical analysis) was calculated as the inverse of the product of: (a) the sampling fraction in the respondent's stratum F_s, and (b) the estimated probability P_R of being a respondent ("response probability") for a tribal member with the respondent's specific characteristics (e.g., age, gender, etc.):

$$W = 1/(F_s * P_R)$$

Response probabilities (P_R) were calculated using logistic regression for survey response among sampled tribal members, using available population characteristics. Available population characteristics included:

[NPT] age group, gender, ZIP code group (83540, 83536, 83501, Other), and fisher indicator.
[SBT] age group, gender, ZIP code group (83203, Other), fisher indicator, and off-reservation indicator.

[BOTH]
Logistic regression models for response were selected using the Hosmer-Lemeshow goodness of fit statistic (Hosmer and Lemeshow, 2000). The selected models included

[NPT] age group, ZIP code group (83540, 83536, 83501, Other), and fisher indicator.
[SBT] age group, gender, fisher indicator, and off-reservation indicator, the age group–fisher interaction and the age group–gender interaction.

The same weights were applied to all weighted analyses (including the analysis of the FFQ and 24-hour consumption data).

Replicate weights from bootstrap re-sampling (1,000 re-samples) were used to calculate the variance estimators (standard errors, confidence intervals, p-values). See the section on replicate weight calculations, below, for more detail.

5.21 Consumer/Non-Consumer Determination (Overall and per Species)

[BOTH]
The analysis included a determination of whether respondents were either fish consumers or fish non-consumers using screening questions in the CAPI (screening interview questions 3–6, see Appendix A). These questions asked the respondent sequentially whether they consumed fish yesterday, last week, last month, or in the past year. [NPT] Only respondents who reported consuming fish in response to the screening questions were further interviewed using the FFQ. Any respondent who did not report consuming fish on the FFQ, despite reporting consumption in response to the screening questions, was categorized as a non-consumer. [BOTH] Consumers of any other designated species group (see Section 5.11) were identified using only the FFQ responses; respondents were considered consumers of the species group if they reported consuming any of the applicable species during the preceding year, including consumption at special events and gatherings.

5.22 Mean, Variance and Percentile Methods for non-NCI analyses

[BOTH]
Estimates of means, variances and percentiles were carried out using standard survey estimate methods implemented in the R survey package (Lumley, 2014 and Lumley, 2004). For the estimates of the percentiles, the package uses a method described in Francisco and Fuller's 1986 (Iowa State University) technical report, *Estimation of the Distribution Function With a Complex Survey.* The survey package also enables inference (estimation of means, variances, percentiles, percentages) in specific groups. When estimating quantities in sub-populations the methodology accounts for the uncertainty in the weights derived for a specific sub-population. The methodology is further described in Lumley, 2010.

5.23 NCI Method

5.23.1 Overview

The NCI method was used to estimate the distribution of usual fish consumption from the 24-hour recall data. Compared to the consumption reported on the FFQ, 24-hour consumption would be expected to have a smaller recall bias. The 24-hour assessment refers to consumption "yesterday" while the FFQ asks about typical values of consumption for the preceding year. The analysis of reported 24-hour consumptions, however, presents analytical challenges. The specific challenges for fish consumption are described in Polissar et al., 2014. Points (1) to (6), below, are adapted (and extended for application in the present context) from that document.

The NCI method involves fitting a model for usual intake (grams/day) of a commodity, such as fish, based on data from a survey with reported consumption on two or more days. The mean and percentiles of consumption are estimated from a derived distribution of usual intake, which is part of the fitted model. The model assumes:

(1) There is an underlying distribution of true usual intake for the population being studied. The true intake for a given person might be thought of as their average daily intake—averaged over the course of a year, often reported as grams per day. The usual intake for a person does not have the ups and downs that occur with intake for any given day; the usual intake is a single number for each person. This usual, average or "true" intake would typically vary from person to person in the population. The set of values of usual intake would typically have relatively few people at very low or very high values of intake and relatively more people in between.

    The set of usual intake values for a population do not have to form a "bell-shaped curve," but the true distribution, it is assumed in the NCI methodology, can be transformed to the normal (bell curve) distribution in a fairly flexible manner, specified by the methodology. (It is noted that fish consumption distributions tend to be skewed toward large consumption values and can often be approximated by the lognormal distribution; this phenomenon is consistent with the "transformation-to-the-bell-shape" assumption here.)

(2) There is day-to-day variation in how much a person consumes of a commodity—on days when they do consume. The daily consumption varies around their usual intake.

    The estimate of the day-to-day variation is a critical part of the NCI model and requires a substantial number of respondents that report consumption on two days ("double-hits"). The ability to run the NCI model is directly impacted by the number of available double-hits.

    The numbers of double-hits for species Group 1 (all finfish and shellfish species) and for species Group 2 (near coastal, estuarine, freshwater and anadromous species) were small in the two tribes involved in the fish consumption survey: 43 double-hits for the Nez Perce Tribe and 8 for the Shoshone-Bannock Tribes for Group 1 consumption, and 28 for the Nez Perce Tribe and 3 for the Shoshone-Bannock Tribes for species Group 2 consumption. Thus, a single NCI model for each species group was fit to data from both tribes combined. Covariates capturing differences between the two tribes in the likelihood to consume fish on a given day and in the consumed amount were introduced into the model to allow the estimation of tribe-specific distributions. A substantial number of respondents with Group 1 consumption on at least one of two 24-recall days was available to enable the inclusion of covariates into the model (179 NPT respondents and 56 SBT respondents with fish consumption on at least one of the two 24-hour recall

days). The numbers of respondents was smaller for Group 2 species with 145 NPT and 31 SBT respondents with positive 24-hour recall for Group 2. As a sensitivity analysis to the primary NCI models that combined the two tribes, NCI models were also run for the NPT only. The small number of double-hits for the SBT precluded the contractors from fitting an NCI model for the SBT only. The combined-tribes model results are presented in this report, since, under certain assumptions, they are expected to be more precise than results from a model based on only one of the Tribes.

(3) There is a certain probability that a person will consume on any given day, and this probability can vary from person to person. For example, there can be frequent and infrequent consumers of fish.

(4) There may be a correlation between the amount consumed on a consumption day and the frequency of consumption. For many foods, those people who consume the food more frequently also consume more of it on the actual consumption day (Tooze et al., 2006).

(5) All survey respondents who are included in the analysis are assumed to be fish consumers. This includes the possibility that the consumption rate of some consumers may be very low. The FFQ data were used to determine if a responder was a consumer of fish (or a specific species group) in this study.

(6) The distribution may be influenced by individual factors. The NCI method also has the option of including responder-specific covariates in the modeling (e.g., FFQ consumption, gender). The covariates can be used to modify the distribution based on covariate values. For example, responders with higher FFQ consumption can have a different distribution of fish consumption rates than responders with lower FFQ consumption, and use of gender as a binary covariate can produce a different distribution for each gender. The selection of covariates into the NCI model is further described in Section 5.23.2. Another reason for including covariates into the NCI model is to estimate the distribution for specific groups. Inclusion of a covariate in the model states that the consumption frequency or amount (or both) vary across the groups (or values) of the covariate. After the NCI model is fit the estimation of the distribution in the overall population as well as in specific groups defined by the model covariates is available.

(7) Consumption may vary depending on the day of the week. Continuing development of the key points described above, in addition to the responder-specific covariates, the NCI method can also adjust for weekday-weekend differences in consumption and over- or under-representation of weekend or weekday interviews in the completed pool of 24-hour recall interviews. For the purpose of this study, the “weekend” was defined as Friday, Saturday and Sunday and weekdays as Monday through Thursday. Friday has been included in the definition of the weekend for this analysis, since consumption on Friday has been found to be more similar to consumption on the traditional two-day weekend than

to consumption on other weekdays (Haines et al., 2003, in a study of the U.S. general population). The weekday/weekend adjustment accounts for: (a) the difference in the consumption rate between weekdays and weekends, (b) the weekday/weekend mix among each respondent's 1st and 2nd 24-hour recall interviews, and (c) The noted potential over- or under-representation of weekdays or weekends in the pool of completed interviews.

The NCI method can also adjust for differences in consumption between the first and subsequent interviews ("sequence effect"). The sequence effect adjustment in this study introduces into the model an indicator variable for the 2nd vs. 1st interview. Subsequent model predictions used in calculating the mean and percentiles of the usual consumption distribution (the main end product of the NCI method) key the estimates to the mean consumption rate found in the first interview. In this analysis, both the weekday-weekend and the sequence effect adjustments have been applied. This choice was recommended by NCI staff (personal communication from Kevin Dodd to Moni Neradilek on June 22, 2015) who frequently use the NCI method in dietary studies. The NCI staff found these two adjustments to be important in past application of the NCI method to the NHANES study. The contractors also carried out a sensitivity analysis to assess the impact of these two adjustments on the estimated distributions. The results of the sensitivity analysis are available in Appendix E, Section 9.4.4.

This section and subsequent sections present methodology relevant to the analysis by the NCI method. Readers who are particularly interested in this approach to estimating the distribution of usual consumption may wish to also review Appendix E, which has important additional information on the use of the NCI method for this report.

Additional notes on the NCI methodology are available in Tooze et al., 2006. An instructive webinar series featuring Dr. Tooze and others is available on the web (http://riskfactor.cancer.gov/measurementerror). The SAS statistical programming language code for carrying out the calculations using the NCI methodology (version 1.1) is available online (http://riskfactor.cancer.gov/diet/usualintakes/macros_single.html.). A newer version of this software (version 2.1), obtained directly from the NCI team, was utilized.

5.23.2 Covariate Selection

[BOTH]
The use of covariates, if properly selected, can improve the consistency of the model with the 24-hour recall data and provide better estimates of the mean and percentiles of consumption for the population or sub-population being considered. The covariates considered for inclusion in the NCI model were:

- FFQ fish-consumption rate per respondent for the same species group for which the distribution of usual intake was desired (i.e., the Group 1 FFQ consumption rate was used as a covariate for analysis of the Group 1 24-hour recall consumption data and Group 2 FFQ rates were used as a covariate for the 24-hour recall data from Group 2)
- presence vs. absence on the fishers list

- gender
- ZIP code groups (83540, 83536, 83501 and Other for the Nez Perce Tribe and 83203 and Other for the Shoshone-Bannock Tribes)
- age (grouped as 18-29, 30-39, 40-49, 50-59 and 60+)
- the responder's weight (in pounds)

A dichotomous tribe indicator was included as a covariate in all models.

Among the listed covariates, covariates were selected that were judged to have an impact on the NCI-estimated consumption rates. The contractors added a candidate covariate and its interaction with tribe into the model and visually compared the differences in the means and percentiles of the model-estimated consumptions within groups defined by the covariate. For example, for the fishers list covariate the contractors compared the NCI-estimated statistics (mean and percentiles) between fishers and non-fishers within each tribe. Large differences between different levels or categories of the covariate suggested inclusion of the covariate in the NCI model. To arrive at the best fit for continuous covariates (FFQ and the respondent's weight), different transformations of the covariate were considered: 3^{rd} root, log and ordered decile number.

The selection of covariates was carried out in two steps. As it was expected that FFQ consumption rates would be strongly related to the 24-hour recall consumption rates, the contractors first considered FFQ as a covariate in the model and attempted to find the best transformation of FFQ that predicts the 24-hour recall rates as analyzed through the NCI method. Linear effects of the FFQ were considered in four forms: the original (untransformed) value, the 3^{rd} root value, the $\log_{10}$ value and the numerical decile of FFQ (coded as $1–10$[10]). To examine the goodness of fit of the four forms the mean, median, 90^{th} percentile and 95^{th} percentile of consumption were calculated by the NCI method within each decile of FFQ for each of the four forms and compared to the same statistics calculated by the NCI method using the FFQ decile as a categorical variable (see Appendix section 9.4.1 and Figures E2 and E9 for more detail). On visual inspection, the 3^{rd} root and the $\log_{10}$ transformations best followed the trend in the categorical decile (true for species Group 1 and for species Group 2 models). As the lambda (λ) parameter[11] for both species group models was relatively close to the 3^{rd} root (lambda = 1/3), the 3^{rd} root FFQ was chosen as the primary model choice. Analysis by the NCI method with $\log_{10}$ FFQ was carried out as a sensitivity analysis. The sensitivity analysis is presented in Appendix E, Section 9.4.4 and further details regarding the choice between FFQ transformations are presented in Appendix E, Section 9.4.1. Finally, the contractors discovered that the 24-hour recall consumption in the 10^{th} FFQ decile among the SBT respondents was considerably lower than expected by the trend in the continuous FFQ and an indicator for this group was added into the model to improve the model fit.

The second step involved considering the inclusion of the remaining covariates into the model. The candidate variables available included presence/absence on the fishers list, gender, ZIP code group (83540, 83536, 83501 and Other for the Nez Perce Tribe, and 83203 and Other for the

[10] The deciles were defined separately within each tribe.

[11] Lambda (λ) is the power exponent used to transform a normal distribution to a distribution appropriate as one component of a model consistent with the dietary recall data being analyzed.

Shoshone-Bannock Tribes), and age (grouped as 18−29, 30−39, 40−49, 50−59 and 60+). All of these variables had an impact on the estimated distribution of usual fish consumption distribution from the NCI method and were included in the NCI models. Respondents' body weight (tried in the modeling as untransformed, 3^{rd} root, $\log_{10}$ and the decile rank) had no or only a weak relationship with the estimated consumption distribution and was therefore not included as a covariate. The selected covariates were used in two model components of the NCI method: the model for the probability of consuming the designated fish species (e.g., Group 2) on a randomly selected day and the model for the amount of the fish species eaten during the day, given that consumption occurred on the specific day.

The 3^{rd} root of FFQ was also selected as the covariate for the Group 2 model. However, due to the small number of single- and double-hits of Group 2 in the SBT, a model with several covariates was found to be unstable and the remaining covariates (presence on the fishers list, gender, ZIP code and age) were not included in the final Group 2 model for the combined Tribes. The final model for Group 2 consumption thus consisted of tribe (dichotomous), 3^{rd} root of FFQ and its interaction with the tribe variable. When the distribution of the Group 2 consumption was to be estimated within subgroups (e.g., by gender) the corresponding covariate (e.g., gender) was added into the final Group 2 model for the specific subgroup analysis only.

Prior to selecting the covariates, potential seasonal variation in Group 1, Group 2 and salmon 24-hour recall consumption rates were explored. For each tribe, the mean consumption by month was plotted (see Figures E1, E8 and E24 in the Appendix for the Group 1, Group 2 and salmon displays, respectively). As the consumption values differed between the 1^{st} and 2^{nd} interviews, the means were calculated separately for the 1^{st} and 2^{nd} interview data for a more direct comparison across months. While some variability across the months exists, no difference or pattern was discerned indicating seasonal differences vs. empirical noise, due to the small sample size for each month. We further corroborated these findings in the 24-hour recall data by examining seasonal patterns in mean Group 1 FFQ consumption (Appendix Figure E25). Also, there might be seasonal variation in access to fishers for interviews due to their seasonal absence from home. Such absence might affect the mix of interviewees by month and induce a time pattern of consumption, particularly consumption of salmon. A plot of the monthly percentage of respondents that were fishers (Appendix Figure E26) shows no clear indication of seasonal differences.

More details on covariate selection can be found Appendix E, Section 9.4.1.

5.23.3 Quality Checking of the Model

[BOTH]
The NCI method is a powerful yet complex method to estimate the distribution of the usual consumption from the 24-hour recall data. A few simple analyses were therefore conducted to assess the validity of the NCI model estimates.

In the first quality check the contractors examined the distribution of the consumed amounts. An important assumption of the NCI method is that the transformed positive consumption amounts

(fish consumption on days when consumption occurred) are normally distributed. To verify this assumption the contractors examined the (survey-weighted) histograms of the transformed (3^{rd} root) respondent-specific mean consumption (for the respondents' one or two days which included fish consumption) and the within-person residuals (for respondents with double-hits) for the data from the two tribes combined.

The second quality check consisted of comparison of demographic subgroup means for sampled days with non-zero fish consumption from: (a) the NCI method (considering only the consumption amount part of the NCI model), and (b) means from a "naïve" approach: traditional weighted survey means, calculated directly from the 24-hour recall consumption data (including only days with non-zero consumption).

The naïve approach was carried out in three alternative forms, depending on which interviews were used in the calculations: 1) all interviews, 2) interviews for respondents with two interviews and 3) only first interviews. Choices #1 and #2 are more comparable to the NCI method in that they also utilize both interviews and allow examination of the covariate effects on the consumption rates in both interviews. Choices #1 and #2, however, do not account for the sequence effect (2^{nd} vs. 1^{st} interview) and the results could therefore be systematically lower or higher compared to the results from the NCI model (as the NCI model adjusts for the sequence effect). The results from choice #3 (1^{st} interview only) should be more comparable to the NCI model estimates with regard to the adjustment for the sequence effect, as the NCI model adjusts for the sequence number and calculates the consumption rate distribution keyed to the mean of the first interview. Some differences between all three choices of the naïve approach and the NCI model estimates are still possible because the NCI model adjusts for differences between weekdays and weekend while the naïve approach does not. The estimates that were compared between the naïve and the NCI methods were consumption probabilities and means of positive consumption days for groups defined by covariates included in the NCI model. The naïve and NCI-method means were compared within categories of the following variables: presence/absence on the fishers list, gender, ZIP code group, age and the FFQ rate (categorized in deciles). The comparison of the NCI and naïve approaches was carried out for consumption of Group 1 species only.

A final check of the NCI method estimates involved re-computing the estimates by an independent statistician. The estimates (mean and percentiles) of the Group 1 consumption distribution from the NCI method were checked by a member of the NCI staff who deals regularly with the NCI method (personal communication from Kevin Dodd to Moni Neradilek on July 2, 2015). The staff member's Group 1 means and percentiles were all within 0.4% of the contractors' estimates for the Nez Perce Tribe and within 0.9% for the Shoshone-Bannock Tribes.

5.23.4 Sensitivity Analyses

[BOTH]

While building the NCI model several choices were made. These choices included: 1) using the 3rd root transformation for the FFQ covariate, 2) using the weekend adjustment and the sequence effect adjustment, and 3) including a number of other covariates in the final model for the distribution of usual consumption of Group 1 species. To quantify the impact of these choices on the estimated distributions, a sensitivity analysis was run with alternative choices. (All sensitivity analyses were carried out for Groups 1 and 2 species unless noted otherwise.) Specifically, the log transformation for the FFQ covariate was considered instead of the 3rd root transformation. A model without the weekend/weekday adjustment was also considered, as was a model without the sequence effect adjustment. For each of these three alternatives, only the specific item (e.g., weekend/weekday) was changed or omitted in the model and all other covariates from the final model were unchanged.

Three additional sensitivity analyses were carried out: (a) a model based on the NPT data only, (b) a simpler model (for Group 1 species only) than the final model (certain covariates were not included in the model), and (c) a model assuming zero correlation between the daily probability of consuming fish and the amount of fish consumed on a true consumption day.
The model based on the NPT data alone was created to compare the means and percentiles from the final model—using both Tribes' data—to means and percentiles from a model using just one Tribe's data (NPT). The relatively small number of single- and double-hits in the SBT data required that the final models be fitted to data from both Tribes combined, and that covariates be introduced into the model to capture differences between the Tribes[12]. As the number of hits in NPT was sufficient to run certain models without problems, a sensitivity analysis was carried out by running the NCI models with the NPT data only and then comparing the results to the final estimates from the two-Tribe model.

To examine the impact of combining numerous covariates in the NCI model, a sensitivity analysis was run in which only a single covariate was added to a model that initially included Tribe (dichotomous), FFQ consumption rate, the Tribe-FFQ interaction and an indicator variable for the 10th decile of the FFQ consumption rate in the SBT.

Finally, an important methodological feature of the NCI method is that it can include a non-zero correlation between the probability of consumption on a random day and the consumption amount on a true consumption day. In order to investigate the impact of the correlation assumption, a sensitivity analysis was run forcing the correlation to be zero (no correlation) in the NCI models.

5.24 Effect of Changes in Study Design on FFQ Rates

[NPT]

[12] As noted previously, the NCI model based on combined data from the two Tribes was used for the final estimates of means and percentiles of fish consumption for each Tribe. These estimates are expected to be more precise, under certain assumptions, than estimates based on a model using data from a single Tribe.

An assessment was conducted to determine the impact of two study design changes on overall fish consumption. The first impact was that of interviews conducted at special events. All interviews conducted on September 25–27, 2014 and October 17–19, 2014 were considered as interviews at special events. The second consideration was the impact of non-tribal interviewers compared to tribal interviewers.

Another assessment was also conducted to determine whether interviews conducted at home differed in fish consumption from interviews not conducted at home. Although this is not a design change, the comparison was of interest because this variable might have had an effect on the reported consumption. The results of the home/not home analysis are presented along with the results on design changes for convenience.

The impact of the design variables on fish consumption was calculated both without and with an adjustment for respondent characteristics. The unadjusted analysis consisted of the calculation of FFQ means and medians of fish consumption in the two groups and the estimation of the difference of the two means. The latter was estimated from linear regression (with the same statistical weighting of respondents as in the calculation of means and percentiles). Linear regression was also used in the adjusted analysis and included respondent characteristics in addition to the tested design variable. The characteristics included ZIP code (categorized as 83536, 83501 or others combined), age category (<30, 30–39, 40–49, 50–59 and 60+), gender, on/off reservation residence, fishing (questions 35 and 36) and the respondent's physical weight (as a continuous predictor). Including the respondent characteristics in the regression controls for differences in the fish consumption that may be due to the respondent's personal characteristics and not to the tested design variables.

5.25 Effect of Home vs. Non-Home Interview on FFQ Rates

[SBT]
An assessment was conducted to determine whether interviews conducted at home differed in fish consumption from interviews not conducted at home.

The impact of the home interview on fish consumption was calculated both without and with an adjustment for respondent characteristics. The unadjusted analysis consisted of the calculation of FFQ means and medians of fish consumption in the two groups (home vs. not home) and the estimation of the difference of the means. The latter was estimated from linear regression (with the same respondent statistical weighting as in the calculation of means and percentiles). Linear regression was also utilized in the adjusted analysis and included respondent characteristics in addition to the tested design variable. The characteristics included ZIP code (83203 vs. others), age category (<30, 30–39, 40–49, 50–59 and 60+), gender, on- vs. off-reservation, fisher or fishing activity (questions 35 and 36 of the questionnaire) and the respondent's physical weight (as a continuous predictor). Including the respondent characteristics in the regression controls for differences in the fish consumption that may be due to the respondent's characteristics and not to the tested design variable.

5.26 Confidence Intervals

[BOTH]
Confidence intervals express the uncertainty of the estimated population means and percentiles of fish consumption. The confidence intervals in this report were calculated using the bootstrap replicate weight method (Lumley, 2010), which is a standard statistical methodology for calculating confidence intervals and incorporates relevant sources of uncertainty. In this method, 1,000 replicate weights (random perturbations of the adjusted sampling weights) are first calculated (see Section 5.26 for more detail). The replicated weights are then saved for use in all subsequent confidence interval calculations (see Section 5.27 for more detail). The bootstrap method for confidence intervals was applied to all weighted analyses (including the analysis of the FFQ and 24 hour consumption rates). Running the NCI model for 1,000 replicate weight sets in the bootstrap procedure took over 3 days of computation for species Group 1; therefore, the confidence intervals were calculated only for the Group 1 mean and percentiles.

[BOTH]
These confidence intervals do not account for any clustering of respondent by household. For example, people who live together may tend to consume more similarly than randomly selected individuals from different households. This correlation between individuals within the same cluster would tend to decrease the precision of the mean and percentile estimates (widen the confidence intervals). The contractors investigated the potential impact of not accounting for clustering with the help of the Tribe(s). The Tribe(s) reviewed the list of respondents and their contact information, as maintained by the tribal enrollment office at the time the sample was drawn, to determine which respondents did live together around the time the survey was conducted. The review was based on address and the reviewer's knowledge of the population.

[NPT]
Based on this review by the Tribe, there were 35 household clusters that comprised 81 members of the 451 respondents with a completed FFQ interview and calculable consumption rate (see Appendix D for a complete list of respondents' survey ID codes). Of the 35 clusters, 27 had a pair of respondents, seven had three respondents and one had five respondents.

[SBT]
Based on this review by the Tribes, there were 12 household clusters that comprised 25 members of the 226 respondents with a completed FFQ interview and calculable consumption rate (see Appendix D for a complete list of respondents' survey ID codes). Of the 12 clusters, 11 had a pair of respondents and one had three respondents.

[BOTH]
If, very conservatively, only one respondent per cluster had been included in the analysis, the effective sample would have been reduced by [NPT] 46 to a net of 405 respondents [SBT] 13 to net of 213 respondents, [BOTH] implying that consumption information from additional respondents within the same household is completely "redundant"—a highly conservative and unrealistic assumption. This reduction in effective sample size would lead to only a [NPT] 5.5% [SBT] 3.0% [BOTH] increase in the confidence interval widths of the mean Group 1 consumption rate, under a simple random sampling scenario. As this impact is quite small and

would only occur under a very extreme and unlikely scenario, the confidence interval methodology was not modified to account for clustering.

5.27 Replicate Weight Calculations

[BOTH]
A total of 1,000 bootstrap replicates were utilized. In the calculations, each replicate bootstrap accounted for two sources of uncertainty: the random sampling of members from the population in each stratum and the non-response model.

The sampling uncertainty was addressed by drawing 1,000 non-parametric bootstrap re-samples. Each non-parametric bootstrap re-sample consisted of a stratified random sample from the original sample, sampling with replacement. Specifically, the strata were the strata used in drawing the random sample for the study (see Section 5.5) and the sample was the sample of the participants drawn for this study (also see Section 5.5). Each random draw was selected from all sampled tribal members (both non-responders and responders) in each sample stratum. Logistically, the recorded information from the non-parametric bootstrap procedure was the number of times (N_i) each respondent was drawn in each bootstrap resample *i*. Note that for observations not being drawn into a given re-sample, $N_i = 0$.

The uncertainty in the non-response model was also addressed by the non-parametric bootstrap. For each of the 1,000 bootstrap resamples the response probabilities predicted by the logistic response model (described in Section 5.20) were recalculated after the model was refit to each bootstrap resample. The response probabilities from bootstrap i are denoted by P_{Ri}. The non-response adjusted replicate weights were then calculated for all responders in the bootstrap resample. Replicate weights W_i (*i* denotes the bootstrap index) were calculated as the inverse of the product of: (a) the sampling fraction per stratum (F_s) and (b) the parametric bootstrap response probabilities (P_{Ri}), and then multiplied by the number of bootstrap resamples for a given observation:

$$W_i = N_i / (F_s * P_{Ri})$$

The 1,000 sets of bootstrap replicate weights were saved and used for all confidence interval calculations.

5.28 Confidence Interval Calculations for a Specific Statistic

[BOTH]

Calculations for specific statistics were carried out on the subset of responders that were relevant for that statistic (e.g., consumers of Group 2 fish species would be included for Group 2 calculations of the mean, median and other percentiles).

The statistic of interest (a mean, percentiles or a regression coefficient) were than calculated on the relevant subset of responders (e.g., Group 2 fish consumers) for each bootstrap realization. Issues with item-specific missing values in this step were automatically handled by the subset function in the R software (by excluding the observations with missing values and adjusting the weights to accommodate the actual number of observations used in the analysis). The 95% confidence interval limits for a statistic were calculated as the 2.5^{th} and the 97.5^{th} percentiles of the bootstrap distribution of the specific statistic across the 1,000 bootstrap realizations.

5.29 Handling Missing Values

[BOTH]
As with all surveys, the interviewers strove to obtain complete responses from all respondents and to avoid any missing values. However, in a survey of this size and complexity, missing values are unavoidable and a concerted effort was made to handle the missing values in an appropriate manner.

During an interview, the respondents usually had the option of indicating "don't know or refused" to avoid responding to a specific question, but could continue on to the subsequent question. In those situations, missing values were dealt with in multiple ways, depending on the type of variable with missing data or its importance. If a *non-consumption-related* response or variable was missing (e.g., respondent weight in pounds or household income), the respondent was simply excluded from any analysis involving that variable.

In contrast, if the missing variable *was* a consumption rate component, then a value was imputed. The consumption rate components that were imputed in the case of "missingness" were portion frequency (e.g., portions per week), portion size (based on portion models) and, if the respondent reported consumption in two periods (e.g., higher/lower or in season/out of season), the length of the higher consumption period as a percentage of the year (see Section 5.11 on consumption rate calculations). The imputation procedure was based on the specific rate component missing and the corresponding species and was always derived from observed, similar responses without "missingness," as described below.

[NPT]
In the sample, respondents reported consuming 6.2 species on the average and 13% of respondents had at least one missing component among any species reported. In total, there were 2,810 species-specific consumption responses (across all combinations of species and respondents), of which 3.2% had a missing component. This rate of missingness is relatively low, given the large number of combinations of respondents and species, but the missingness needed to be addressed due to the total number of respondents with some missingness.

[SBT]

In the sample, respondents reported consuming 7.8 species on the average and 18% of respondents had at least one missing component among any species reported. In total, there were 1,769 species-specific consumption responses (across all combinations of species and respondents), of which 3.7% had a missing component. The rate of missingness was relatively low at the species level, but the missingness needed to be addressed due to the total number of respondents with some missingness.

[BOTH]
The guiding principle to the imputation procedure was to impute only individual consumption rate components rather than the final consumption rate itself, which can vary many-fold between individuals. In general, the value imputed was a mean calculated from similar responses that had no missing values, where "similar" means that the species or species group was the same as for the given respondent's record with a missing value. For example, if a respondent reported consuming Chinook salmon by describing consumption during higher and lower consumption periods, but did not provide the portion size for the lower-period rate, other responses for Chinook consumption during the lower consumption period, without missingness, would be selected for imputation. The mean portion size from those similar responses would then be calculated and used in place of the missing portion size. If there were less than five other similar records to use for imputing a missing value, related species were grouped to increase the sample size. All groupings used are fully specified in Appendix C.

Imputation of missing values was performed according to the following rules:

1. **Both portion frequency and portion size are missing.**
   If a respondent provided neither how often he or she consumed a species nor in what portion size, both frequency and portion size were imputed to 0, which resulted in a consumption rate of 0 grams/day for that specific species.

2. **Portion frequency is missing but portion size is not**
   If the respondent reported how much he or she consumed per portion but not the frequency, the frequency was imputed using the mean value computed using records from the same species and from the same period type, where period type was the whole year, higher consumption period, or lower consumption period. If fewer than 5 such records were available, similar species were grouped together to provide a larger sample size. Details on how species were grouped is described in Appendix C.

3. **Portion size is missing but portion frequency is not**
   If the respondent reported how frequently he or she consumed but not how much, the portion size was imputed in an analogous way as Case 2 above, using similar records without missing values.

4. **Higher consumption period length is missing**
   If the respondent provided consumption detail for higher and lower consumption periods but did not provide the length of the higher consumption period, this value was imputed using the mean calculated from similar responses for higher consumption periods. As for

Cases 2 and 3 above, the imputation was species-specific unless the sample size was less than 5, in which case similar species were grouped. Appendix C describes this process in more detail.

[SBT]
One additional scenario—where some values were missing—occurred when the respondent was asked specifically about consumption at special events, which uses a different formula than the main portion of the FFQ (see Section 5.10). Specifically, two respondents provided an otherwise complete response for salmon or steelhead consumption at special events but did not provide the percentage of events where these species were consumed. One respondent reported attending three events per year (a low frequency of event attendance) and one reported attending one event per week (a high frequency of event attendance). Similar to the above methodology, the missing percentages were imputed using the mean value from other respondents without missing values. For the respondent with a relatively low attendance frequency, the mean percentage (79.7%) was calculated from respondents who consumed salmon or steelhead at special events and went to 6 or fewer per year. For the respondent with a relatively higher attendance rate, the mean percentage (50.2%) was calculated from respondents who went to three events per month or more

[BOTH]
Once a value was imputed for the missing consumption rate component, the consumption rate was calculated according to Section 5.10 as if the imputed value was the actual value provided by the respondent. Appendix C shows that the final mean and percentiles of consumption rates were similar under a range of possible imputed values, [NPT] demonstrating that the impact of missingness and imputation on the final results was minimal. [SBT] demonstrating that missingness and imputation had a relatively small impact on the final results.

[NPT]
There was one exception to the above rules on handling missing values. One respondent reported consuming Chinook, cod, and crab outside of special events and gatherings, and consuming salmon, steelhead, and sturgeon at special events and gatherings. However, for all species, this respondent did not provide a portion size or frequency. Instead of imputing all of these species as 0 g/day as the above rules prescribe, the rates were considered incalculable and the respondent was excluded from the analysis of consumption rates. The reason for treating this respondent differently is that the pattern of response strongly indicated that the respondent was a consumer of salmon (included in Group 2) because salmon was reported as a consumed species both at special events and gatherings and outside of them. As a rate of zero for both Group 1 and Group 2 would be clearly incorrect in this case and there was no basis for imputation, it was deemed best to exclude the respondent.

5.30 Limited Percentiles for Small Sample Sizes

[BOTH]
Some percentiles may be quite imprecise due to the small sample size of respondents used for the percentile calculation. Such percentiles have generally been indicated, using a rule of thumb

borrowed from random sampling: a percentile was designated as potentially very imprecise if—treating the sample as a simple random sample—there would have been two or fewer respondents with a consumption rate equal to or greater than the noted percentile. Due to the statistical weighting used in the calculation of percentiles, it is possible that in a specific case there may actually be more than two respondents (in the sample used to calculate the percentile) with a rate at or exceeding the noted percentile value. Nevertheless, this approximate method does provide a helpful flag of caution attached to some percentiles. This rule was applied to analyses estimated from traditional survey-weighted techniques (Section 5.22), but not to NCI method analyses (Section 5.23). The latter set of analyses relies on the entire data set, rather than only on the observations in the tail of the distribution to estimate the percentiles.

Confidence intervals for percentiles (described in Section 5.25) may also become less reliable (inappropriately wide or narrow) when the sample size is small. Such intervals have been indicated in cases where there were less than five observations greater than or equal to the corresponding percentile. This rule was applied only to the analyses estimated from traditional survey-weighted techniques, but not to the analyses using the NCI method.

5.31 Large Consumption Values

[NPT]
Histograms (Figure 2) were examined of total consumption based on the FFQ, and three respondents were found with values noticeably higher (1124–1372 g/day) than the other respondents. The weight and gender of each respondent and the details of the species consumed were further examined and the consumption rates were determined to be plausible. Accordingly, the respondents were retained in the analysis without modification of any data.

[SBT]
Histograms (Figure 2) were examined of total consumption based on the FFQ, and three respondents were found with values noticeably higher (1058–1068 g/day) than the other respondents. The weight and gender of each respondent and the details of each species consumed were further examined and the consumption rates were all determined to be plausible. Accordingly, the respondents were retained in the analysis without modification of any data.

[NPT]

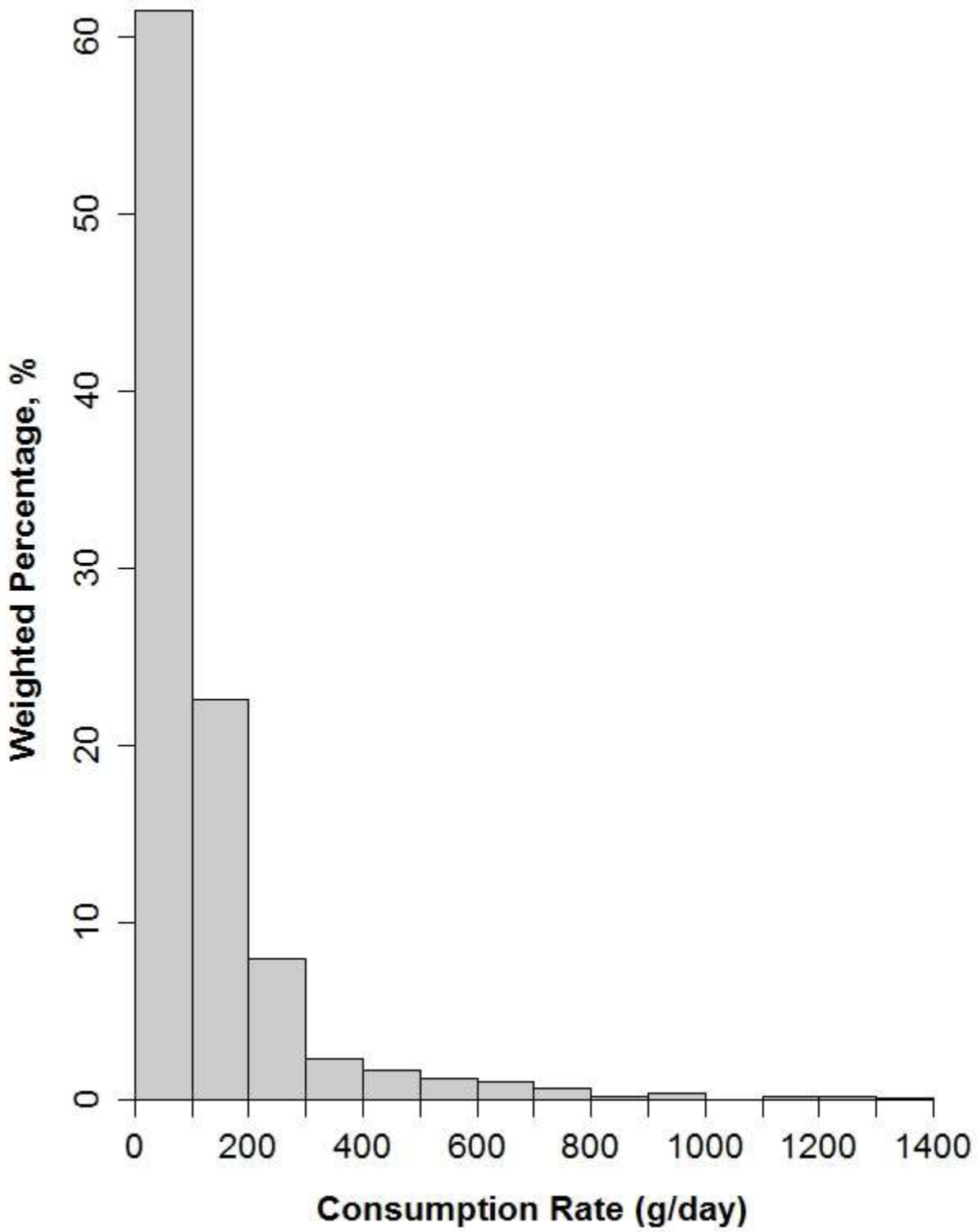

Figure 2. Nez Perce Tribe. Histogram of total consumption rates. The bin width is 100 g/day. The percentages (y-axis), corresponding to the frequency of consumers within each bin, are weighted to correspond to the percentage among consumers in the eligible population. The sum of all bars equals 100%.

[SBT]

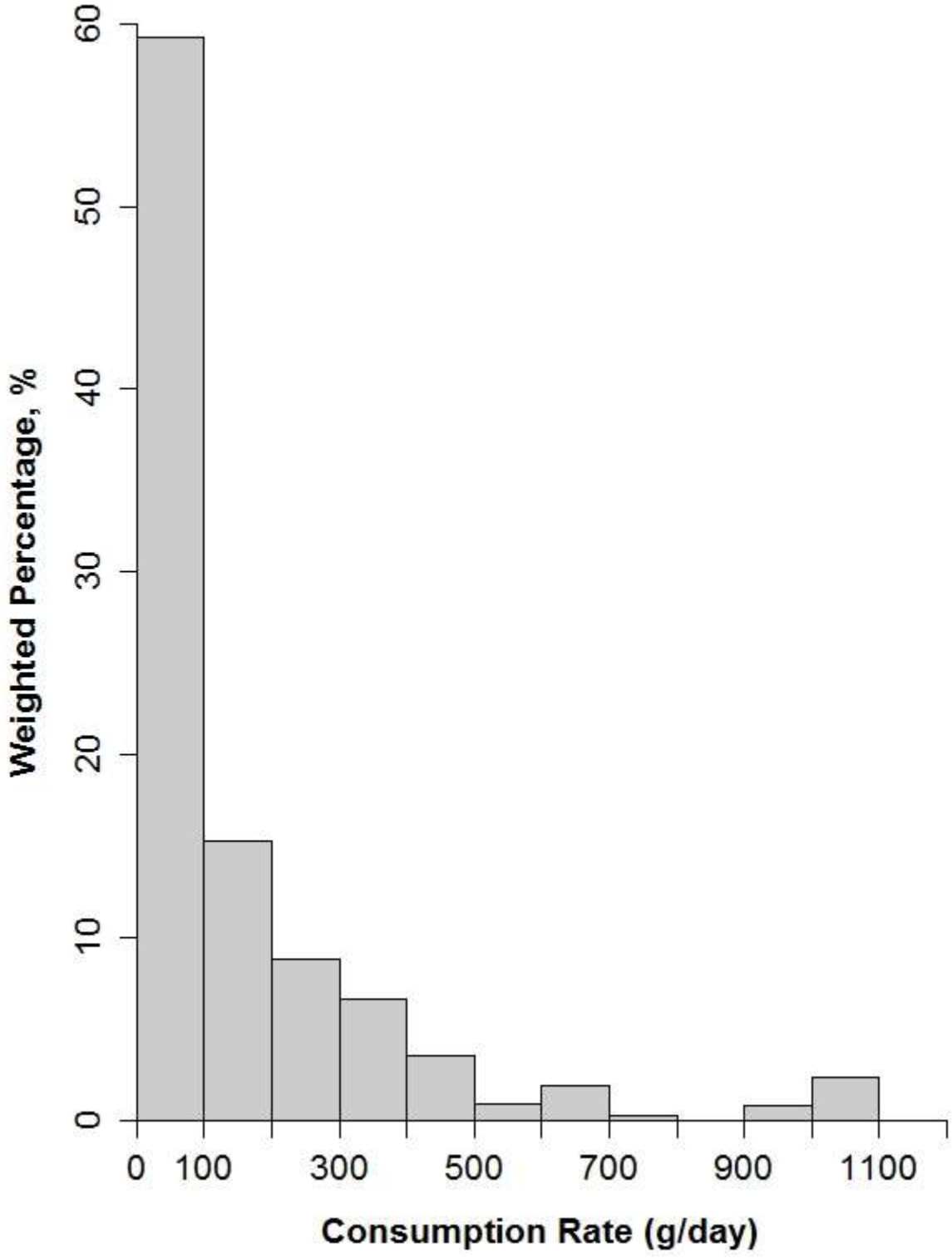

Figure 2. Shoshone-Bannock Tribes. Histogram of total consumption rates. The bin width is 100 g/day. The percentages (y-axis), corresponding to the frequency of consumers within each bin, are weighted to correspond to the percentage among consumers in the eligible population. The sum of all bars equals 100%.

5.32 Software and Software Modules

[BOTH]
Calculations were carried out in R (R Core Team, 2015) versions 3.1.1–3.1.3 and SAS 9.4 (for NCI method analysis only). The weighted survey analyses performed in R used the *survey* package for analysis of complex surveys. (Lumley, 2014 and Lumley, 2004). The NCI method was performed using a SAS macro (version 2.1) that was obtained directly from the NCI team.

6.0 Results

6.1 Response Rates

[NPT]
Table 3 summarizes the overall survey response rate, calculated to be 38.0%. Of the 1250 Nez Perce tribal members originally sampled, 40 were found to be ineligible during the contact attempts by interviewers (e.g., the sampled member lived out of the eligible area, were employed as Tribal interviewers involved in the survey, or were deceased, institutionalized or impaired). For the purpose of overall response rate calculations, the remaining 1210 members were used as the denominator (using the RR1 standard—see AAPOR, 2011).

Of these 1210 members, 472 members adequately responded to the screening interview questions used to distinguish between consumers (n=464) and non-consumers (n=8). One respondent who reported being a consumer on screening reported not consuming on the FFQ, so this respondent was re-classified as a non-consumer for a total of 9 non-consumers. Of the remaining 463 consumers, 452 completed the first interview and 451 had a calculable FFQ consumption rate. The respondent without a calculable rate is described in Section 5.28. The total number of responders with a complete and usable interview was 460, including the 451 consumers with an FFQ rate plus the 9 non-consumers. The overall RR1 response rate was thus 460 of 1210 (38.0%) (Table 3). The number of responders corresponds to 29% of the original population size of 1574.

The 451 consumers with calculable FFQ consumption rates form the primary sample for most tables presented in this report. However, some tables may be based on more or fewer respondents, depending on analysis-specific inclusion/exclusion criteria.

[NPT]
Table 3. Nez Perce Tribe. Survey response rate.

	N or %
Responders*	460
Total sample size**	1210
Response rate (RR1)	38.0%

*Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;
**Excludes 40 tribal members found to be ineligible during contact attempts.

[SBT]
Table 3 summarizes the overall survey response rate, calculated to be 41.9%. Of the 661 members of the Shoshone-Bannock Tribes originally sampled, during the contact attempts by interviewers 47 were found to be ineligible (e.g., lived out of area, were employed as Tribal interviewers involved in the survey, or were deceased, institutionalized or impaired). For the purpose of overall response rate calculations, the remaining 614 members were used as the denominator (RR1 standard, see AAPOR, 2011).

Of these 614 members, 269 members responded to the screening interview questions used to distinguish between consumers (n=238) and non-consumers (n=31). Of the 238 consumers, 226 completed the first interview and had a calculable FFQ consumption rate. The total number of responders with a complete and usable interview was 257, including the 226 consumers with an FFQ rate plus the 31 non-consumers. The overall RR1 response rate was thus 257 of 614 (41.9%) (Table 3). The number of responders corresponds to 7.9% of the original population size of 3242.

The 226 consumers with calculable FFQ consumption rates form the primary sample for most tables presented in this report. However, some tables may be based on more or fewer respondents, depending on analysis-specific inclusion/exclusion criteria.

[SBT]

Table 3. Shoshone-Bannock Tribes. Survey response rate.

	N or %
Responders*	257
Total sample size**	614
Response rate (RR1)	41.9%

*Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;
**Excludes 47 tribal members found to be ineligible during contact attempts.

6.2 Factors Effecting Response Rates

[NPT]

This section uses a more conservative definition of response to the survey—ineligible members are *not* excluded from the denominator. The sample size and population size are defined and meaningful numerical counts, whereas the number of ineligibles detected in the survey depends on various survey-specific factors, such as total survey effort. The contractors did not wish to use a survey-influenced denominator for response rates in this section; hence, the entire sample or population is used in the denominators here. Due to the small number of sampled members found to be ineligible to be interviewed, as noted in Section 6.1, the inclusion of the ineligibles in the denominators of response rates in this section results in a small underestimate of those response rates[13]. That underestimation is unlikely to have much impact on the difference in response rates between sample or population subgroups.

The response rate did vary quite substantially by demographic characteristics of the selected sample. Tables 4 and 5 summarize the details. The response rate among males was higher than among females (41% vs. 33%), those on the fishers list ("documented fisher")[14] had a

[13] [NPT] The rate of ineligibility in the entire sample is likely to be between 3% and 9%, based on 40 known ineligibles among those contacted within a sample size of 1210, from which 460 became respondents. Calculations: 40/1210 = 3%, 40/460 = 9%

[14] [NPT] NPT staff have noted that the fisher list was derived from the Department of Fisheries Resources Management (DFRM) information on specific individual tribal members who were sampled during their fishing activity at a certain river/area. These are tribal members observed or interviewed as fishing at a certain area during a

substantially higher response rate than non-fishers (48% versus 33%), and those in the most tribally populated ZIP code, 83540, had a substantially higher response rate than those in other ZIP codes (46% vs. 22–26%).

Age was an important factor in determining response; among females and males, the youngest members of the selected sample had the lowest response rate (the age range of 18–29 had a response rate of 16% for females and 28% for males, vs. 34–43% for other ages among females and 29–58% for other ages among males).

Table 4. Nez Perce Tribe. Response rates by sampling strata. Estimates are unweighted.

			Responded**		
Group	**No. in Population***	**Total No. Sampled***	**No.**	**% of Sample**	**% of Pop.**
All	1574	1250	460	36.8%	29.2%
Sampling Strata					
Female Age 18-29	191	152	25	16.4%	13.1%
Age 30-39	145	115	40	34.8%	27.6%
Age 40-49	152	121	52	43.0%	34.2%
Age 50-59	153	122	42	34.4%	27.5%
Age 60 or older	175	139	57	41.0%	32.6%
Male Age 18-29	178	141	39	27.7%	21.9%
Age 30-39	160	127	56	44.1%	35.0%
Age 40-49	144	114	66	57.9%	45.8%
Age 50-59	130	103	49	47.6%	37.7%
Age 60 or older	146	116	34	29.3%	23.3%

*Ineligible members are *not* excluded; the response rates are thus somewhat underestimated;
**Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate.

certain fishery season, and is not a comprehensive representation of all "fishers" of the Tribe. They serve as a "fisher indicator" for purpose of this survey. This will allow comparison their rates to other Tribal members who were not "documented" as fishers through the Tribe's sampling program and monitoring activities.

Table 5. Nez Perce Tribe. Response rates by demographic characteristics. Estimates are unweighted.

Group	No. in Population*	Total No. Sampled*	Responded ** No.	% of Sample	% of Pop.
All	1574	1250	460	36.8%	29.2%
Gender					
Male	758	601	244	40.6%	32.2%
Female	816	649	216	33.3%	26.5%
Documented Fisher* **					
Yes	371	288	139	48.3%	37.5%
No	1203	962	321	33.4%	26.7%
Zip Code					
Lapwai – 83540	906	729	336	46.1%	37.1%
Kamiah – 83536	196	151	39	25.8%	19.9%
Lewiston – 83501	172	136	30	22.1%	17.4%
Other	300	234	55	23.5%	18.3%

*Ineligible members are *not* excluded; the response rates are thus somewhat underestimated;
**Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;
***Refer to section 4.3 on Populations for a description of documented fishers. Some respondents who were not documented fishers did or do fish.

[SBT]
This section uses a more conservative definition of response to the survey—ineligible members are *not* excluded from the denominator. The sample size and population size are defined and meaningful numerical counts, whereas the number of ineligibles detected in the survey depends on various survey-specific factors, such as total survey effort. The contractors did not wish to use a survey-influenced denominator for response rates in this section; hence, the entire sample or population is used in the denominators here. Due to the small number of sampled members found to be ineligible to be interviewed, as noted in Section 6.1, the inclusion of the ineligibles in the denominators of response rates in this section results in an underestimate of those response rates[15]. That underestimation is unlikely to have much impact on the difference in response rates between sample or population subgroups.

Response rates did vary by demographic factors. Tables 4 and 5 summarizes the details. Males had a response rate of 39%, the same as the female response rate. Those on the fishers list ("documented fishers") had a substantially higher response rate than non-fishers: 46% versus 33%. Those who lived on the reservation had a higher response rate than those living off-reservation (40% versus 33%).

[15] [SBT]The rate of ineligibility in the entire sample is likely to be between 8% and 18%, based on 47 known ineligibles among those contacted within a sample size of 614, from which 257 became respondents. Calculations: 47/614 = 8%, 47/257 = 18%

Age also played a strong role in the response rates. Among non-fishers on the reservation, the lowest response rate was among those age 18–29 (27%) vs. those of older ages (response rates ranging from 33% up to 39%).

[SBT]

Table 4. Shoshone-Bannock Tribes. Response rates by sampling strata. Estimates are unweighted.

			Responded**		
Group	**No. in Population***	**Total No. Sampled***	**No.**	**% of Sample**	**% of Pop.**
All	3242	661	257	38.9%	7.9%
Sampling Strata***					
Live off reservation (any age)	448	56	18	32.1%	4.0%
Age 18-29 (on reservation)	809	93	25	26.9%	3.1%
Age 30-39 (on reservation)	535	67	26	38.8%	4.9%
Age 40-49 (on reservation)	420	55	21	38.2%	5.0%
Age 50-59 (on reservation)	361	49	16	32.7%	4.4%
Age 60 or older (on reservation)	370	42	14	33.3%	3.8%
Documented fisher (any age)	299	299	137	45.8%	45.8%

*Ineligible members are *not* excluded; the response rates are thus somewhat underestimated;
**Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;
***Sampling strata are mutually exclusive; all documented fishers are counted in the designated fisher stratum, regardless of age or whether they live on or off the reservation.

Table 5. Shoshone-Bannock Tribes. Response rates by demographic factors. Estimates are unweighted.

Group	No. in Population*	Total No. Sampled*	Responded** No.	% of Sample	% of Pop.
All	3242	661	257	38.9%	7.9%
Gender					
Male	1566	410	159	38.8%	10.2%
Female	1676	251	98	39.0%	5.8%
Documented Fisher* **					
Yes	299	299	137	45.8%	45.8%
No	2943	362	120	33.1%	4.1%
Zip Code					
Fort Hall – 83203	2723	589	233	39.6%	8.6%
Other	519	72	24	33.3%	4.6%
Live on Reservation					
Yes	2786	597	236	39.5%	8.5%
No	456	64	21	32.8%	4.6%

*Ineligible members are *not* excluded; the response rates are thus somewhat underestimated;
**Either was determined to be a non-consumer or completed the first interview and had a calculable FFQ consumption rate;
***Refer to section 4.3 on Populations for a description of documented fishers. Some respondents who were not documented fishers did or do fish.

6.3 Consumers, Non-Consumers and Frequency of Consumption

[NPT]
Non-consumption of fish was rare among the Nez Perce Tribe, as shown in Table 6. An estimated 2.6% of the adult tribal members do not consume fish. The single most common reason for non-consumption reported was not liking fish at 87% of non-consumers. Other common reasons included too busy (36%), do not know how to prepare (28%) and allergy or health concern (25%). The vast majority (87%) of consumers reported eating fish once per week or less often, while about 10% eat fish 1–2 times per week (Table 6). However, this frequency information was determined during the relatively short screening interview and did not involve detailed probing of consumption patterns.

Of the 463 consumers who responded, 452 completed the first interview which collected detailed consumption information. One respondent did not provide enough information to calculate an FFQ consumption rate (described in more detail in Section 5.28), so the remaining 451 respondents with calculable FFQ rates formed the primary sample for most tables presented in this report. However, some tables may be based on more or fewer respondents depending on analysis-specific inclusion/exclusion criteria.

Table 6. Nez Perce Tribe. Frequency of fish consumption based on 472 responders to the screening questionnaire. Estimates are weighted.

		Unweighted %	*No.*	*Weighted %*
Consumer*	Yes	98.1%	463	97.4%
	No	1.9%	9	2.6%
If consumer, how many days per week?**	≤ 1	86.3%	314	87.3%
	1-2	10.4%	38	9.6%
	2-3	2.8%	10	2.5%
	3-4	0.0%	0	0.0%
	4-5	0.6%	2	0.6%
	5-6	0.0%	0	0.0%
	6-7	0.0%	0	0.0%
If non-consumer, why?***	Contamination	0.0%	0	0.0%
(multiple reasons allowed)	Availability	0.0%	0	0.0%
	Access to fishing	12.5%	1	7.3%
	Do not like fish	75.0%	6	87.0%
	Too busy to catch or prepare	25.0%	2	35.6%
	Do not know how to prepare	12.5%	1	28.4%
	Cannot afford fish	12.5%	1	7.3%
	Allergies or health concerns	25.0%	2	34.0%
	Vegetarian or vegan	0.0%	0	0.0%
	Religious customs	0.0%	0	0.0%

*Consumer status was determined primary from the screening interview. Only respondents who sufficiently completed the interview to determine consumer status were considered responders. One respondent claimed to be a consumer during screening but then denied being a consumer during the first interview. This respondent was classified as a non-consumer;
**364 consumers responded to this question;
***8 non-consumers responded to this question.

[SBT]
Non-consumption of fish was infrequent among the Shoshone-Bannock Tribes, as shown in Table 6. An estimated 20% of tribal members are non-consumers. The single most common reason for non-consumption reported was not liking fish. Fish consumption is highly prevalent (80%), but most days of the week do not involve fish consumption (Table 6). The vast majority (90%) of consumers eat fish once per week or less often, while about 8% eat fish 1–2 times per week. However, this frequency information was determined during the relatively short screening interview and did not involve detailed probing of consumption patterns.

Of the 238 consumers who responded, 226 completed the first interview which collected detailed consumption information. These 226 respondents formed the primary sample for most tables presented in this report. However, some tables may be based on more or fewer respondents depending on analysis-specific inclusion/exclusion criteria.

Table 6. Shoshone-Bannock Tribes. Rate of fish consumption based on 269 responders to the screening questionnaire. Estimates are weighted.

		Unweighted %	*No.*	*Weighted %*
Consumer*	Yes	88.5%	238	79.8%
	No	11.5%	31	20.2%
If consumer, how many days per week**	≤ 1	90.3%	177	90.1%
	1-2	7.6%	15	7.9%
	2-3	2.0%	4	2.0%
	3-4	0.0%	0	0.0%
	4-5	0.0%	0	0.0%
	5-6	0.0%	0	0.0%
	6-7	0.0%	0	0.0%
If non-consumer, why?***	Contamination	7.1%	2	7.7%
(multiple reasons allowed)	Availability	7.1%	2	3.5%
	Access	0.0%	0	0.0%
	Do not like fish	75.0%	21	75.7%
	Too busy to catch or prepare	10.7%	3	10.4%
	Do not know how to prepare	10.7%	3	10.8%
	Cannot afford fish	3.6%	1	3.5%
	Allergies or health concerns	3.6%	1	3.9%
	Vegetarian or vegan	0.0%	0	0.0%
	Religious customs	0.0%	0	0.0%

*Consumer status was determined from the screening interview. Only respondents who sufficiently completed the interview to determine consumer status were considered responders;
**196 consumers responded to this question;
***28 non-consumers responded to this question.

6.4 Demographic Characteristics

[NPT]
The tribe is diverse in demographic composition. Table 7 shows that in addition to the expected diversity of gender and age, most of the respondents live in households with three or more persons, about a quarter of the population are fishers, almost all of the population has finished high school or obtained a GED (99%) and nearly half of members have attended some college (45%). The household income is also diverse but with the majority of Tribal member respondents falling into the range of $15,000–$45,000 per year annual household income. Of the consumers included on the fishers list, 87% were male while 38% of non-fishers were male. More than half of fishers (56%) were between 18 and 39 years old.

Among female consumers, 82% reported giving birth. Of these women, 75% reported breast-feeding or providing breast milk to their babies. Of those women who have finished breast-feeding their youngest child, the median reported age at which they stopped was 6 months (range: 1 to 46 months).

[NPT]

Table 7. Nez Perce Tribe. Demographic characteristics of consumers. Estimates are weighted.

		% or mean ± SD	No. Responded
Gender*	Male	49.9%	451
	Female	50.1%	
Age*	18-29 years	21.5%	451
	30-39 years	19.6%	
	40-49 years	19.2%	
	50-59 years	17.8%	
	60 years or older	21.8%	
Weight, kgs		89.4 ± 19.9	434
Weight, kgs (males only)		96.6 ± 19.4	239
Weight, kgs (females only)		81.7 ± 17.5	195
No. in household	1	8.8%	451
	2	19.4%	
	3-4	42.8%	
	5 or more	29.0%	
Documented fisher*	Yes	24.2%	451
	No	75.8%	
Live on reservation	Yes	82.7%	449
	No	17.3%	
Highest education	Middle school	1.2%	448
	High School / GED	54.0%	
	Associates degree	26.4%	
	Bachelor's degree	12.4%	
	Master's degree	5.2%	
	Doctorate	0.8%	
Annual household income	≤ $15K	20.5%	410
	$15K – $25K	20.8%	
	$25K – $35K	20.0%	
	$35K – $45K	12.6%	
	$45K – $55K	8.1%	
	$55K – $65K	5.6%	
	>$65K	12.3%	

*From the Tribal enrollment file or the Fishers List; other demographics were determined from the questionnaire. Refer to section 4.3 on Populations for a description of documented fishers. Some respondents who were not documented fishers did or do fish.

[SBT]
The tribe is diverse in demographic composition. Table 7 shows that in addition to the expected diversity of gender and age, the majority of the respondents live in households with three or

more persons, 11% of the population are fishers, over 90% of the population has finished high school or obtained a GED, and 27% of the members have attended some college. The household income is also diverse but with 42% of Tribal member respondents falling into the range of $15,000–$45,000 per year annual household income. Of the consumers included on the fishers list, 85% were male while 40% of non-fishers were male. Nearly half of fishers (47%) were between 40 and 59 years old.

Of the female consumers, 83% reported giving birth. Of these women, 56% reported breast-feeding or providing breast milk to their babies. Of those women who have finished breast-feeding their youngest child, the median age at which they stopped was 6.4 months (range: 1 to 24 months).

Table 7. Shoshone-Bannock Tribes. Demographic characteristics of consumers. Estimates are weighted.

		% or mean ± SD	No. Responded
Gender*	Male	45.5%	226
	Female	54.5%	
Age*	18-29 years	27.7%	226
	30-39 years	21.2%	
	40-49 years	16.8%	
	50-59 years	16.4%	
	60 years or older	17.9%	
Weight, kgs		92.9 ± 23.3	219
Weight, kgs (males only)		101.9 ± 23.1	140
Weight, kgs (females only)		85.1 ± 20.5	79
No. in household	1	11.4%	226
	2	19.3%	
	3-4	38.4%	
	5 or more	31.0%	
Documented fisher*	Yes	11.2%	226
	No	88.8%	
Live on reservation*	Yes	87.3%	226
	No	12.7%	
Highest education	Elementary school	1.6%	223
	Middle school	6.7%	
	High School / GED	64.7%	
	Associates degree	16.3%	
	Bachelor's degree	7.1%	
	Master's degree	3.6%	
	Doctorate	0.1%	
Annual household income	≤ $15K	26.6%	144
	$15K – $25K	18.7%	
	$25K – $35K	8.4%	
	$35K – $45K	14.5%	
	$45K – $55K	9.0%	
	$55K – $65K	11.4%	
	>$65K	11.3%	

*From the Tribal enrollment file or the Fishers List; other demographics were determined from the questionnaire. Refer to section 4.3 on Populations for a description of documented fishers. Some respondents who were not documented fishers did or do fish.

6.5 FFQ Rates for Species and Groups of Species

[NPT]
FFQ consumption rate statistics for the Nez Perce Tribe, which include special event consumption, are shown in Table 8. The Group 1 (all fish) consumption distribution is skewed toward large values due to a number of consumers with high consumption rates. The mean of 123.4 grams per day among the 451 consumers with a calculable consumption rate is accompanied by a standard deviation of 159.4, larger than the mean, indicating skewness toward large values. In addition, the mean (123.4 g/day) is larger than the median (70.5 g/day), another indication of skewness.

The 90th percentile of consumption, 270.1 grams per day, is more than twice the mean and approximately four times the median, and the 95th percentile of consumption, 437.4 grams per day, is approximately triple the mean and over six times as large as the median. The maximum observed consumption rate was 1,371.9 grams per day.

Confidence intervals are presented for the means and percentiles of consumption. The width of a confidence interval is a measure of the uncertainty in the specific estimated value. Regardless of the width of the confidence interval, the estimated rate (statistically referred to as the "point estimate") is a useful value and is methodologically superior to any other choice within the confidence interval as an estimate of the percentile, because it has been derived by an unbiased method. It is a wrong to assume for these survey results that the range of a confidence interval—from lower bound to upper bound—is a level field with all consumption rate values in it having equal merit for being the choice for the true population value. The choice of the "point estimate," for example, of 437.4 grams per day for the 95th percentile (FFQ method, Group 1 species), is the only estimate within the interval that is derived by an unbiased procedure. It is the only unbiased value to use as the 95th percentile.

In Group 2, the mean consumption rate is somewhat lower at 104.0 grams per day, and the median consumption rate for group 2, 61.3 grams per day, is approximately 85% as large as the median for Group 1, Once again, this species group's consumption rate has values skewed toward high consumption rates, weighting to a 90th percentile of 231.4 grams per day and a 95th percentile of 327.9 grams per day. The maximum Group 2 consumption rate of 1323.8 grams per day is, again, large but plausible. The consumption rates are presented in a graphical format in Figures 2 and 3.

Groups 3 through 7 are mutually exclusive and completely subdivide Group 1. Among Groups 3–7 the most consumed group is Group 3 (salmon and steelhead), with 446 consumers and a mean consumption rate of 79.0 grams per day, followed by Group 6 (marine finfish and shellfish), with 308 consumers and a mean rate of 51.0 grams per day. Groups 4 (resident trout) and 5 (other freshwater finfish and shellfish) had similar consumption with 136 and 150 consumers, respectively, and mean rates of 13.5 grams per day and 14.3 grams per day. There were only 2 consumers of Group 7 (species not specified sufficiently well to place in one of the aforementioned groups), with a mean rate of 8.1 grams per day.

[SBT]
Table 8 shows the FFQ consumption rate distributions for the Shoshone-Bannock Tribes, which includes special event consumption. The Group 1 (all fish) consumption rates are large, and skewed to the right, as indicated by the comparison of the mean (158.5 grams per day) and median (74.6 grams per day). Specifically, the mean is more than twice the median, and the 90th and 95th percentiles are five- to eight-fold larger than the median. The standard deviation of 215.5 also indicates a large skewness toward high-fish-consuming members of the population. The maximum consumption rate is 1068.2 g/day.

Group 2 fish consumption follows a similar pattern of consumption rates, with a mean of 110.7 grams per day, a median of 48.5 grams per day and a very large standard deviation of 163.5 grams per day, plus 90th and 95th percentiles of consumption that are substantially larger than the mean or the median. The maximum consumption rate is 1029.2 g/day.

Confidence intervals are presented for the means and percentiles of consumption. The width of a confidence interval is a measure of the uncertainty in the specific estimated value. Regardless of the width of the confidence interval, the estimated rate (statistically referred to as the "point estimate") is a useful value and is methodologically superior to any other choice within the confidence interval as an estimate of the percentile, because it has been derived by an unbiased method. The choice of the "point estimate," for example, of 603.4 grams per day for the 95th percentile (FFQ method, Group 1 species), is the only estimate within the interval that is derived by an unbiased procedure. It is the only unbiased value to use as the 95th percentile. .

The consumption rates are presented in a graphical format in Figures 2 and 3. The skewness toward large consumption rates is apparent from the plots where the accumulation of population members (percentages on the vertical axis) tapers off at a shallow angle toward the right as the consumption rate increases. There is distinctly a subpopulation of tribal members with very large consumption rates.

Groups 3 through 7 are mutually exclusive and completely subdivide Group 1. The most consumed group is Group 6 (marine finfish and shellfish), with 222 consumers and a mean consumption rate of 98.8 grams per day, followed by Groups 3 (salmon and steelhead) and 4 (resident trout), with 215 and 130 consumers, respectively, and mean rates of 47.6 grams per day and 22.1 grams per day. There were 97 consumers of Group 5 (other freshwater finfish and shellfish), with a mean rate of 11.2 grams per day. There were only 2 consumers of Group 7 (species not specified sufficiently well to place in one of the aforementioned groups), with a mean rate of 1.8 grams per day.

[NPT]

Table 8. Nez Perce Tribe. Mean, median and selected percentiles of annual fish consumption rates (g/day) in the Nez Perce Tribe, based on the FFQ; consumers only. Estimates are weighted.

	No. of				Percentiles											
Species Group*	Consumers	Mean	SD	Min	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	***99%	Max
Group 1 (all finfish and shellfish)	451	123.4	159.4	0.4	70.5	79.1	91.2	109.5	124.5	137.6	163.9	207.4	270.1	437.4	795.9	1371.9
(95% CI)		(108.7-146.5)			(63.6-80.8)	(69.4-94.8)	(76.8-109.8)	(88.6-126.7)	(106.4-147.4)	(123.9-166.6)	(143.9-206.3)	(174.8-264.7)	(221.0-340.3)	(309.5-522.6)	(562.1-1172.0)	
Group 2 (near coastal/estuarine/freshwater/anadromous)	446	104.0	144.2	0.2	61.3	69.0	77.7	91.5	103.6	123.3	145.1	175.2	231.4	327.9	764.5	1323.8
(95% CI)		(92.0-125.9)			(52.2-69.5)	(59.7-80.3)	(66.7-94.2)	(76.8-105.6)	(88.9-128.2)	(104.1-146.9)	(127.6-176.3)	(151.1-222.9)	(195.8-288.6)	(250.9-489.9)	(500.9-1150.2)	
Group 3 (salmon or steelhead)	446	79.0	119.7	0.2	45.2	49.5	58.0	65.6	75.7	89.4	107.1	131.7	166.1	247.3	706.7	949.8
(95% CI)		(68.9-96.0)			(38.4-55.3)	(45.9-61.9)	(51.0-70.0)	(58.8-79.3)	(67.5-96.6)	(78.3-110.9)	(97.7-135.4)	(114.1-163.1)	(145.9-205.5)	(200.7-438.1)	(431.1-798.1)	
Group 4 (resident trout)	136	13.5	42.5	0.03	3.8	5.3	5.8	7.3	7.9	9.0	13.0	19.9	26.3	56.8	**129.3	544.2
(95% CI)		(8.2-28.0)			(1.9-6.2)	(2.8-7.5)	(3.7-8.1)	(5.1-10.4)	(5.7-13.9)	(7.5-19.3)	(8.1-22.0)	(11.0-32.4)	(18.8-56.5)	(28.6-89.9)	(56.3-428.3)	
Group 5 (other freshwater finfish and shellfish)	150	14.3	32.1	0.02	3.7	5.0	6.2	7.5	8.6	11.2	14.9	20.4	34.2	75.9	**109.2	309.5
(95% CI)		(9.4-21.9)			(2.0-5.7)	(2.7-7.2)	(3.4-8.4)	(4.2-11.1)	(5.3-14.6)	(7.2-20.5)	(8.7-29.3)	(12.1-45.1)	(19.0-75.0)	(34.7-103.2)	(77.6-237.5)	
Group 6 (marine finfish and shellfish)	308	51.0	77.6	0.1	29.8	33.8	37.9	44.9	52.8	57.7	70.0	74.9	93.3	155.4	363.0	731.8
(95% CI)		(42.3-63.5)			(25.1-34.4)	(28.4-40.6)	(30.6-46.7)	(34.5-53.0)	(42.0-58.1)	(48.6-70.3)	(56.3-80.0)	(68.4-105.5)	(80.1-151.2)	(124.4-288.9)	(255.6-521.6)	
Group 7**** (unspecified finfish and shellfish)	2	8.1	4.9	-	-	-	-	-	-	-	-	-	-	-	-	-

*See Table 2 for definitions of species groups;

**Two or fewer expected respondents with rates equal to or greater than the reported percentile (approximately); interpret this percentile more cautiously;

***Confidence intervals for the 99th percentile are less reliable because there are less than 5 respondents equal to or greater than the reported percentile (approximately); interpret these intervals more cautiously;

****There were only 2 consumers of unspecified species so only the mean and SD are presented.

[SBT]

Table 8. Shoshone-Bannock Tribes. Mean, median and selected percentiles of annual fish consumption rates (g/day) in the Shoshone-Bannock Tribes, based on the FFQ; consumers only. Estimates are weighted.

	No. of				Percentiles											
Species	Consumers	Mean	SD	Min	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	***99%	Max
Group 1 (all finfish and shellfish)	226	158.5	215.5	0.8	74.6	86.2	106.5	120.3	157.1	212	233.6	310.3	392.5	603.4	1058.5	1068.2
(95% CI)		(118.3-201.2)			(52.0-107.8)	(64.3-119.5)	(74.8-155.8)	(90.7-187.4)	(108.4-232.8)	(128.4-278.3)	(162.7-317.6)	(228.5-444.0)	(279.3-575.7)	(380.4-923.9)	(609.6-1059.4)	
Group 2 (near coastal/estuarine/freshwater/anadromous)	225	110.7	163.5	0.1	48.5	57.9	70.9	82.9	103.1	140.2	164.1	211.1	265.6	427.1	792.6	1029.2
(95% CI)		(82.6-144.0)			(32.8-71.3)	(39.3-83.1)	(49.8-102.6)	(62.1-135.6)	(73.4-158.4)	(85.8-179.2)	(123.0-222.4)	(156.6-279.0)	(189.9-396.0)	(256.1-745.8)	(479.6-813.9)	
Group 3 (salmon or steelhead)	215	47.6	78.4	0.3	15.4	18.2	21.8	26.9	34.1	56.3	72	95.6	142.3	233.1	329.6	825.2
(95% CI)		(34.7-65.5)			(9.4-21.8)	(11.6-26.0)	(16.5-34.1)	(19.2-51.8)	(23.4-70.6)	(28.9-83.6)	(41.8-106.2)	(67.8-164.3)	(84.8-237.0)	(133.9-322.8)	(241.3-338.2)	
Group 4 (resident trout)	130	22.1	53.3	0.1	4.6	7.4	7.9	14.9	14.9	15.5	29.8	33.5	56	68.3	**340.6	374.7
(95% CI)		(12.6-41.0)			(2.3-9.0)	(2.6-14.9)	(3.7-15.2)	(5.6-16.3)	(7.5-29.8)	(8.6-38.0)	(14.9-53.6)	(15.5-60.8)	(29.8-68.7)	(51.8-333.8)	(83.9-351.7)	
Group 5 (other freshwater finfish and shellfish)	97	11.2	17.4	0.02	3.6	4.9	5.9	7	7.6	9.8	16.9	22.5	33.7	43.5	**72.9	76.1
(95% CI)		(6.1-15.3)			(1.9-6.4)	(2.5-7.2)	(2.9-7.7)	(3.2-13.5)	(4.7-16.1)	(5.8-20.5)	(6.9-28.4)	(7.7-35.7)	(14.3-57.8)	***(20.5-70.7)	(34.9-75.0)	
Group 6 (marine finfish and shellfish)	222	98.8	175.1	0.1	37.3	45.6	54.5	68.4	79.5	94.7	119.2	156	221.5	402.6	975.8	1019.5
(95% CI)		(65.5-136.1)			(25.5-54.1)	(30.7-66.5)	(40.7-77.5)	(45.7-85.4)	(56.7-107.5)	(69.2-146.2)	(80.3-189.0)	(101.0-265.9)	(146.2-376.7)	(203.1-719.3)	(406.6-999.0)	
Group 7*** (unspecified finfish and shellfish)	2	1.8	1.2	-	-	-	-	-	-	-	-	-	-	-	-	-

*See Table 2 for definitions of species groups;

**Two or fewer expected respondents with rates equal to or greater than the reported percentile (approximately); interpret this percentile more cautiously;

***Confidence intervals for the 99th percentile and other specified percentiles are less reliable because there are less than 5 respondents equal to or greater than the reported percentile (approximately); interpret these intervals more cautiously;

****There were only 2 consumers of unspecified species so only the mean and SD are presented.

[NPT]

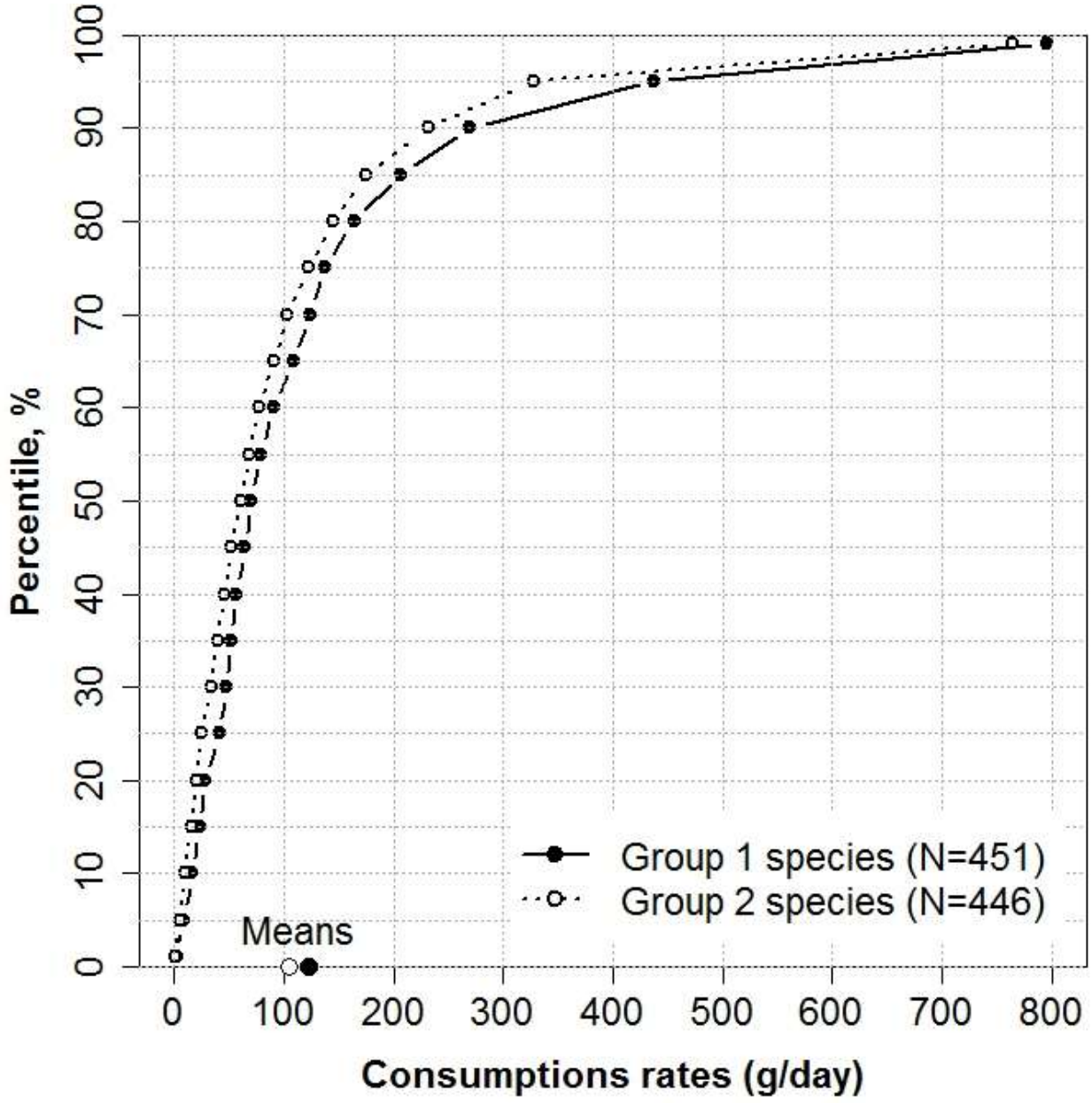

Figure 3. Nez Perce Tribe. Estimated cumulative distribution of total FFQ consumption rates. Group 1 includes all species. Group 2 includes near coastal, estuarine, freshwater, and anadromous species. The percentiles are spaced every 5% on the vertical axis, with the 1st percentile and 99th percentiles also included. Estimates are weighted. The points are the original estimates and the lines (solid and dotted) are linear interpolations between those estimates. The mean consumption rates for both species groups are indicated with points on the horizontal axis.

[SBT]

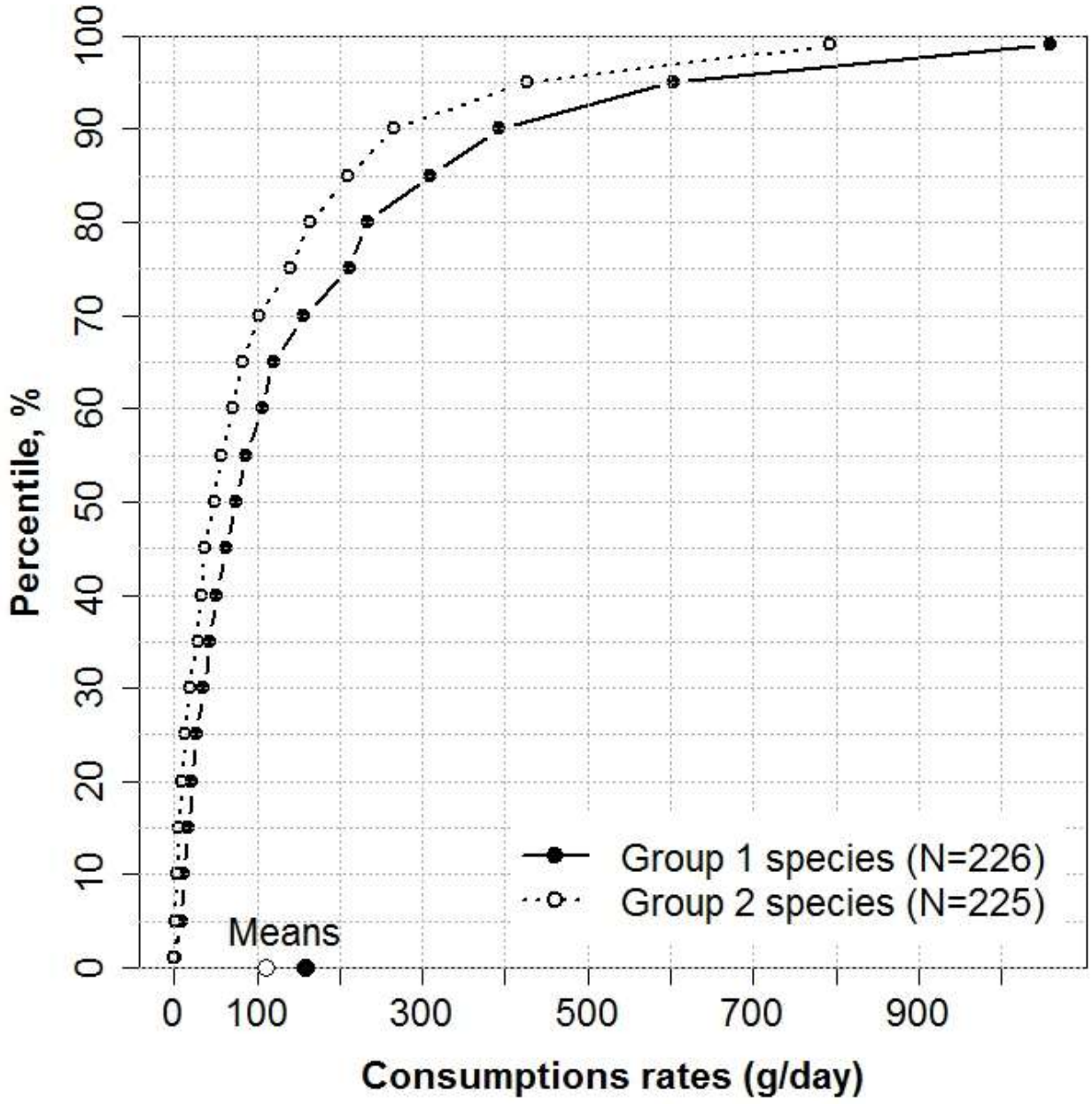

Figure 3. Shoshone-Bannock Tribes. Estimated cumulative distribution of total FFQ consumption rates. Group 1 includes all species. Group 2 includes near coastal, estuarine, freshwater, and anadromous species. The percentiles are spaced every 5% from the 5th percentile to the 95th percentile along the vertical axis. Estimates are weighted. The points are the original estimates and the lines (solid and dotted) are linear interpolations between those estimates. The mean consumption rates for both species groups are indicated with points on the horizontal axis.

6.6 FFQ Consumption Rates by Demographic Groups

[NPT]
FFQ consumption rates for Group 1 (all fish) did vary substantially across some of the demographic factors (Table 9). The documented fishers (fisher indicator list) had a substantially higher consumption rate than the non-fishers (or those tribal members who were not documented as fishing recently through the Tribe's sampling program and monitoring activities). The mean of 171.8 g/day for fishers is 60% larger than the mean for non-fishers at 107.9 g/day. The medians and higher percentiles are also substantially different.

The mean consumption rate for males was higher than the female rate by 46%: a mean of 146.6 g/day versus 100.2 g/day, respectively.

Age had less of an impact on consumption rates, being relatively consistent (mean and median) across all age groups except the oldest age group (60 years or older).

Those living on the reservation had a higher mean consumption than those not living on the reservation; higher percentiles of consumption were also larger for those living on the reservation.

Household size did not show a consistent relationship with consumption rates. Nor did education, with those completing high school (or GED) or less having about the same consumption rate as those who reported some college education. There was also no consistent pattern of consumption rates in relation to household income.

[SBT]
FFQ consumption rates for Group 1 (all fish) in different demographic groups are reported in Table 9. Males had a mean consumption rate that was 39% higher than the mean rate for females: 187.3 g/day vs. 134.4 g/day, respectively. There is no consistent pattern of consumption rates in relation to age across the mean, median, and other percentiles (Table 9). Being on the fishers list did not have a consistent relationship to consumption rates, with a similar mean between fishers and non-fishers but a substantially different median (117.7 g/day for fishers and 69.7 g/day for non-fishers) and differences in the opposite direction in several higher percentiles. The highest percentiles are rather unstable due to the relatively small sample size for estimation at these high percentiles.

Only a small fraction of the respondents lived off-reservation (210 on versus 16 off). The evidence in the table suggests that those who live on the reservation have a higher consumption rate than those who live off-reservation.

Examination of the mean and median consumption rates by household size suggests that those who live alone and those in very large households (five or more) have a lower consumption rate than those with 2–4 household members.

Consumption rates appeared to be higher for those with high school/GED or less education compared to associates degree or higher (mean: 174.6 vs. 124.6 g/day). The pattern was similar for the median and upper percentiles.

Household income also seemed to play a role in relationship to consumption rates, with the lowest consumption rates occurring in the lowest income category (at or less than $15,000 per year) for the mean and median and all higher percentiles.

[NPT]

Table 9: Nez Perce Tribe. Estimated distribution of FFQ consumption rates (g/day) of consumers within demographic subgroups. All rates are for total consumption (Group 1). Estimates are weighted.

	No. of			Percentiles		
Group	Consumers*	Mean	SD	50%	90%	95%
Gender**						
Male	241	146.6	179.3	87.4	285.1	488.3
Female	210	100.2	133.1	54.7	244.0	341.4
Age**						
18-29 years	61	126.7	175.4	74.7	225.2	522.4
30-39 years	94	140.9	161.1	74.0	298.9	448.6
40-49 years	116	115.4	126.1	68.5	241.2	463.3
50-59 years	89	130.3	193.4	67.4	253.8	308.2
60 years or older	91	105.8	136.8	62.3	264.8	332.0
Documented Fisher**						
Yes	138	171.8	207.2	98.0	436.8	543.5
No	313	107.9	137.5	65.5	232.9	337.7
Live on reservation						
Yes	391	127.3	164.4	70.6	284.6	451.0
No	58	106.5	134.4	65.6	202.8	237.5
Number who live in household						
1	37	133.9	179.3	82.0	288.3	***423
2	84	119.0	144.1	57.2	285.3	451.5
3-4	193	119.3	163.7	71.0	224.3	441.0
5 or more	137	129.2	158.0	74.0	284.0	381.1
Highest education						
High school / GED or less	242	126.6	176.5	70.4	253.9	492.0
Associates degree or higher	206	120.4	136.5	70.7	275.0	409.0
Annual household income						
≤ $15K	79	122.9	168.7	69.7	282.4	324.9
$15K – $45K	219	126.6	165.9	71.1	250.8	488.7
>$45K	112	117.7	113.5	72.4	244.8	339.6

*Consumers with unknown or missing subgroup status were excluded for the analysis of that subgroup;
**From the enrollment list or fisher indicator list; other subgroups were determined from the questionnaire;
***Two or fewer expected respondents with rates equal to or greater than the reported percentile (approximately); interpret this percentile more cautiously.

[SBT]

Table 9: Shoshone-Bannock Tribes. Estimated distribution of FFQ consumption rates (g/day) of consumers within demographic subgroups. All rates are for total consumption (Group 1). Estimates are weighted.

	No. of			Percentiles		
Group	Consumers*	Mean	SD	50%	90%	95%
Gender**						
Male	143	187.3	245.5	74.9	452.2	806.0
Female	83	134.4	184.5	65.8	313.6	467.7
Age**						
18-29 years	36	181.9	266.6	61.0	456.1	***653.4
30-39 years	39	197.1	272.4	81.8	498.5	***873.9
40-49 years	51	113.5	122.9	69.6	237.1	287.9
50-59 years	48	157.2	169.1	119.7	298.5	606.2
60 years or older	52	119.6	142.1	74.2	412.5	452.1
Documented Fisher**						
Yes	134	160.9	169.8	117.7	351.1	459.1
No	92	158.2	221.4	69.7	405.4	604.4
Live on reservation						
Yes	210	163.1	223.4	74.7	384.4	620.7
No	16	126.7	151.5	57.3	***389.6	***426.5
Number who live in household						
1	29	120.0	152.0	41.2	335.5	***429
2	54	197.4	239.6	105.4	465.7	659.3
3-4	87	182.2	235.4	94.0	435.6	605.4
5 or more	56	119.1	187.4	52.1	308.0	317.2
Highest education						
High school / GED or less	153	174.6	237.1	77.2	453.3	647.9
Associates degree or higher	70	124.6	148.7	56.5	306.3	330.4
Annual household income						
≤ $15K	31	134.0	145.6	76.6	302.3	***422.5
$15K – $45K	62	153.6	234.2	66.4	424.6	584.4
>$45K	51	173.4	159.3	118.3	333.0	495.2

*Consumers with unknown or missing subgroup status were excluded for the analysis of that subgroup;
**From the enrollment list or fisher indicator list; other subgroups were determined from the questionnaire;
***Two or fewer expected respondents with rates equal to or greater than the reported percentile (approximately); interpret this percentile more cautiously.

6.7 Effect of Changes in Study Design on FFQ Rates

[NPT]

The estimated mean and medians of FFQ fish consumption classified by two variables that reflect mid-survey changes in design are shown in Table 10. The table compares FFQ rates of consumption of Group 1 (all fish) species for interviewing at special events vs. regular interviewing and for tribal vs. non-tribal interviewers. The table also compares FFQ rates for home vs. non-home interviews, which is included here for convenience, though it does not reflect a design change. The corresponding differences in means (comparing interviews with vs.

without a given characteristic), unadjusted or adjusted for other respondent characteristics, are shown in Table 11.

The mean consumption for respondents interviewed at special events was 0.3 grams/day lower compared to respondents not interviewed at special events. This difference reversed and was still small (5.4 grams/day) once respondent characteristics were adjusted for. These differences were not statistically significant (p = 0.8-1.0).

The mean FFQ consumption for respondents with tribal interviewers was 31.7 grams/day lower compared to respondents with non-tribal interviewers. This difference was similar (30.7 grams/day) once respondent characteristics were adjusted for using a multivariate linear regression model (Table 11). Both the unadjusted and adjusted difference were not statistically significant (p = 0.3).

Finally, the mean consumption for respondents interviewed at home was 29.1 grams/day lower compared to respondents interviewed elsewhere. This difference changed very little (23.0 grams/day) once respondent characteristics were adjusted for. Neither the unadjusted nor the adjusted differences were statistically significant (p = 0.2-0.3).

While there are some small numeric effects of the variables considered, they are not statistically significant and there is no need to adjust for them in presenting consumption rates for this population. The effect of these variables on other species groups was not assessed because the main part of this report focuses on Group 1 species and the assessment for the other groups would be more limited due to the smaller sample sizes of data sets limited to the consumers of the other (and more specific) species groups.

Table 10. Nez Perce Tribe. Mean and median Group 1 (all fish) FFQ consumption rates (g/day) by groups according to design variables. Weighted results.

Group	N	Mean	Median
Not special event	393	123.4	72.2
Special event	67	123.1	60.7
Non-tribal interviewer	93	147.9	78.6
Tribal interviewer	365	116.2	68.9
Non-home interview	380	128.0	72.9
Home interview	77	98.9	65.4

Table 11. Nez Perce Tribe. Unadjusted and adjusted differences in mean Group 1 (all fish) FFQ consumption rates (g/day) by the design variables. Linear regression. Weighted results.

	Unadjusted			Adjusted for respondent characteristics*		
difference	*est.*	*SE*	*p*	*est.*	*SE*	*p*
Special event	-0.3	27.0	1.0	5.4	27.1	0.8
Tribal interviewer	-31.7	29.8	0.3	-30.6	28.1	0.3
Home interview	-29.1	20.3	0.2	-23.0	20.2	0.3

*Adjusted for ZIP code (83536, 83501 and others), age category (<30, 30-39, 40-49, 50-59 and 60+), gender, on/off reservation, fishing (questions 35 and 36) and the respondent's physical weight (as a continuous predictor).

6.8 Effect of Home vs. Non-Home Interviews on FFQ Rates

[SBT]
The estimated mean and medians of fish consumption according to a home vs. non-home interview location are shown in Table 10. The corresponding differences in means are shown in Table 11. The mean consumption for respondents interviewed at home was 0.5 grams/day higher compared to respondents interviewed elsewhere. This difference was still small and in the opposite direction (5.6 grams/day lower for home interviewed) once respondent characteristics were adjusted for. Neither the unadjusted nor the adjusted difference was statistically significant (p = 0.9-1.0). As the differences are small and not statistically significant, we did not adjust for this effect in presenting survey consumption rates. This effect on other species groups was not assessed because the main part of this report focuses on Group 1 species and the assessment for the other groups would be more limited due to the smaller sample sizes of data sets limited to the consumers of the other (and more specific) species groups.

[SBT]
Table 10. Shoshone-Bannock Tribes. Mean and median overall FFQ consumption by interview location. Weighted results.

Group	N	Mean	Median
SBT			
Non-home interview	133	158.3	75.4
Home interview	104	158.7	74.1

Table 11. Shoshone-Bannock Tribes. Unadjusted and adjusted difference for the impact of home interview. Linear regression. Weighted results.

	Unadjusted			Adjusted for respondent characteristics*		
difference	*est.*	*SE*	*p*	*est.*	*SE*	*p*
Home interview	0.5	43.5	1.0	-5.6	49.9	0.9

*Adjusted for ZIP code (83203 and others), age category (<30, 30-39, 40-49, 50-59 and 60+), gender, on/off reservation, fishing (questions 35 and 36) and the respondent's weight (as a continuous predictor)

6.9 Consumption Rates from the NCI Method

[NPT]
The 24-hour recall data consisted of 850 interviews (single and paired interviews) from 451 respondents. Of the 850 interviews, 29.8% were conducted on the weekend (Friday, Saturday or Sunday). A total of 399 respondents had two interviews. Of the 399 respondents, 43 respondents had two days with Group 1 positive fish consumptions and 122 respondents had one day with Group 1 positive fish consumptions. The remaining 52 respondents had only one interview. Of the 52 respondents, 14 respondents had one day with Group 1 positive fish consumptions.

There were 446 Group 2 consumers, with a total of 840 interviews, among which 29.9% were on the weekend. Among the respondents in this group, 394 had two interviews. Of the 394 respondents, 33 respondents had two days with Group 2 positive fish consumptions and 108 respondents had one day with Group 2 positive fish consumptions. The remaining 52 respondents had only one interview. Of the 52 respondents, 9 respondents had one day with Group 2 positive fish consumptions.

The mean and selected percentiles of the distribution of the fish consumptions rates calculated from the 24-hour recall data by the NCI method are presented in Tables 12, 13 and 14 and in Figure 4. Table 12 presents statistics for overall fish consumption (species Group 1) and Table 14 for species Group 2 consumption. Table 13 shows the 95% confidence intervals for the species Group 1 statistics among all NPT respondents and among NPT respondents on the fishers list. The bootstrap distributions that were used to derive these distributions are shown in the Appendix Figure E22 (all respondents) and Figure E23 (fisher list only). Only 22 out of the 1,000 bootstrap models (2.2%) did not converge. The 22 resamples were excluded from the confidence interval calculations.

The mean fish consumptions in Groups 1 and 2 among all NPT respondents were 75.0 (95% CI, 57.3-104.6) g/day and 66.5 g/day, respectively. The 95th percentile of the distribution of fish consumptions in Groups 1 and 2 among all NPT respondents were 232.1 (95% CI, 165.0-379.7) g/day and 233.9 g/day, respectively.

Fishers consumed more Group 1 fish than non-fishers (mean 98.2 g/day vs. 67.6 g/day) and men consumed more than women (mean 87.7 g/day vs. 62.3 g/day). The means in the four ZIP code groups (83540, 83536, 83501, and "Other" ZIP codes) were between 63.6 and 84.5 g/day. The

means ranged from 58.1 to 92.5 g/day across the five age groups, with the 60+ age group consuming the least and the 30–39 age group consuming the most. Similar trends were observed for Group 2 species.

More extensive tables that include lower percentiles of the Group 1 distributions, Group 2 distributions and confidence intervals for Group 1 for the additional percentiles reported are available in Appendix Tables E1-E3, respectively.

[SBT]
The 24-hour recall data consisted of 429 interviews from 226 respondents. Of the 429 interviews, 31.9% were conducted on the weekend (Friday, Saturday or Sunday). A total of 203 respondents had two interviews. Of the 203 respondents, 8 respondents had two days with Group 1 positive fish consumptions and 47 respondents had one day with Group 1 positive fish consumptions. The remaining 23 respondents had one interview. Of the 23 respondents, 1 respondent had one day with Group 1 positive fish consumptions.

There were 225 Group 2 consumers, with a total of 427 interviews among which 32.1% were on the weekend. Among the respondents in this group, 202 had two interviews. Of the 202 respondents, 3 respondents had two days with Group 2 positive fish consumptions and 28 respondents had one day with Group 2 positive fish consumptions. The remaining 23 respondents had one interviews. None of the 23 respondents had one day with Group 2 positive fish consumptions.

The mean and selected percentiles of the distribution of the fish consumptions rates calculated from the 24-hour recall by the NCI method are presented in Tables 12, 13 and 14 and in Figure 4. Table 12 presents statistics for overall fish consumption (species Group 1) and Table 14 for species Group 2 consumption. Table 13 shows the 95% confidence intervals for the species Group 1 statistics among all NPT respondents and among NPT respondents on the fishers list. The bootstrap distributions that were used to derive these distributions are shown in Appendix Figure E22 (all respondents) and Figure E23 (fishers list only). Only 22 out of the 1,000 bootstrap models (2.2%) did not converge. The 22 resamples were excluded from the confidence interval calculations.

The mean fish consumptions in Groups 1 and 2 among all SBT respondents were 34.9 (95% CI 20.6-66.2) g/day and 18.6 g/day, respectively. The 95th percentile of the distribution of fish consumptions in groups 1 and 2 among all SBT respondents were 140.9 (95% CI 82.0-312.9) g/day and 80.0 g/day, respectively

Fishers consumed more Group 1 fish than non-fishers (mean 42.4 g/day vs. 33.9 g/day) and men consumed more than women (mean 38.1 g/day vs. 32.2 g/day). The means in the two ZIP code groups (83202 and “Other” ZIPs) were 29.9 and 59.2 g/day, respectively. The means ranged from 24.3 to 51.7 g/day across the five age groups, with the 18–29 age group consuming the least and the 40–49 age group consuming the most. Similar trends were observed for Group 2 species with the exception of gender, where women consumed slightly more than men on average.

More extensive tables that include lower percentiles of the Group 1 distributions, Group 2 distributions and confidence intervals for Group 1 are available in Appendix Tables E1-E3, respectively.

[NPT]

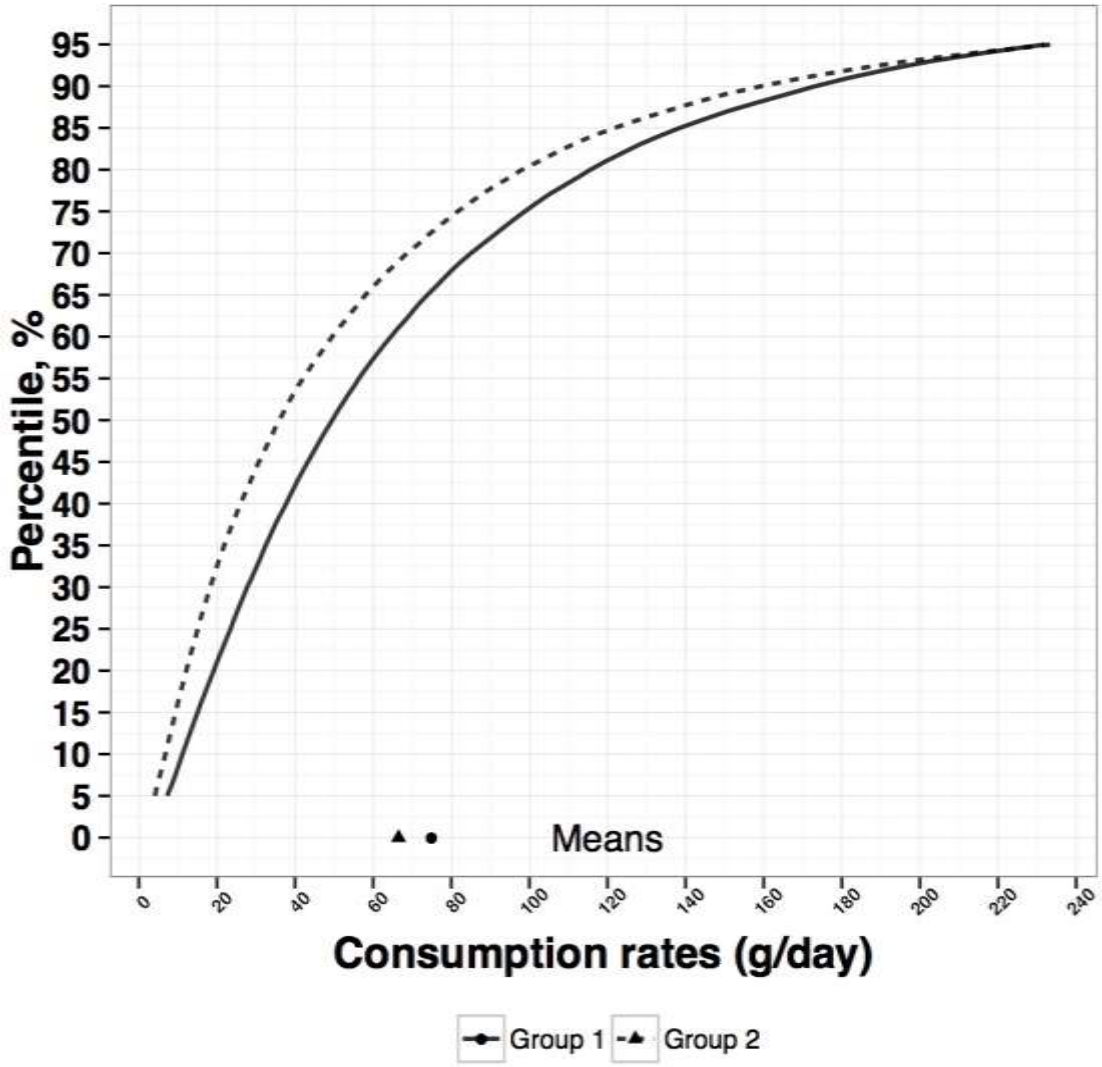

Figure 4. Nez Perce Tribe. Distribution of the usual fish consumption based on the 24-hour recalls. Estimated by the NCI method.

[SBT]

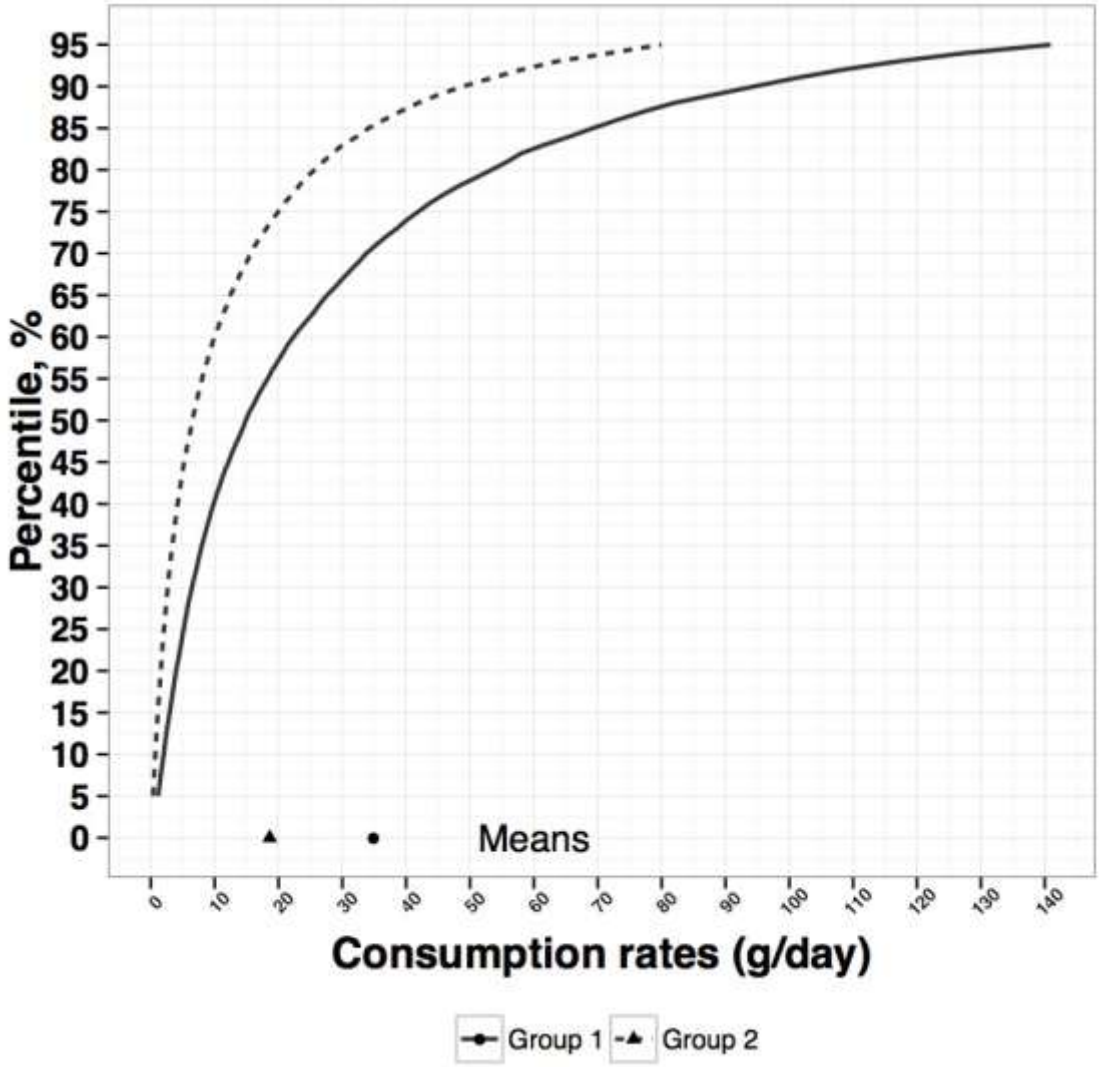

Figure 4. Shoshone-Bannock Tribes. Distribution of the usual fish consumption based on the 24-hour recalls. Estimated by the NCI method.

[NPT]

Table 12. Nez Perce Tribe. Distribution of the usual fish consumption (species Group 1) based on the 24-hour recalls. Estimated by the NCI method.

Group	*N*	*mean*	*p50*	*p55*	*p60*	*p65*	*p70*	*p75*	*p80*	*p85*	*p90*	*p95*
Overall	**451**	**75.0**	**49.5**	**56.4**	**64.6**	**73.9**	**85.1**	**98.9**	**115.7**	**138.5**	**173.2**	**232.1**
Documented fisher												
Fisher	138	98.2	64.7	74.3	85.2	97.9	113.2	130.4	154.1	184.1	229.2	305.0
Non-fisher	313	67.6	45.6	52.0	59.2	67.9	77.6	90.0	104.9	124.6	155.1	206.0
Gender												
Men	241	87.7	58.4	66.7	76.3	87.2	99.8	115.3	134.1	161.9	199.8	268.1
Women	210	62.3	41.8	47.7	54.4	62.4	71.6	82.8	97.7	116.0	145.1	194.4
ZIP Code												
83540	329	73.6	48.2	55.1	62.7	72.1	83.2	96.4	113.1	135.5	168.1	227.2
83536	39	84.5	58.1	67.4	77.4	88.9	101.5	117.6	136.2	164.2	197.9	246.9
83501	28	63.6	48.4	54.5	60.8	67.9	75.2	85.6	98.4	115.8	139.4	177.7
Other	55	79.8	49.2	56.8	65.9	76.5	88.8	102.7	120.7	148.8	193.8	264.2
Age												
18-29	61	75.3	52.0	58.6	66.1	74.7	85.5	97.8	114.3	137.0	170.1	232.5
30-39	94	92.5	64.5	73.1	83.1	94.9	108.5	124.4	143.7	171.2	207.7	274.2
40-49	116	83.8	56.6	64.0	73.1	83.6	97.4	112.5	129.9	157.0	192.6	256.3
50-59	89	66.8	41.2	46.8	54.0	62.0	71.4	83.3	98.0	118.4	151.4	212.7
60+	91	58.1	37.7	43.0	49.6	57.3	67.6	77.7	92.9	110.5	136.5	182.5

Table 13. Nez Perce Tribe. Distribution of the usual fish consumption (species Group 1) and their 95% confidence intervals based on the 24-hour recalls. Estimated by the NCI method.

	N	*mean*	*p50*	*p55*	*p60*	*p65*	*p70*	*p75*	*p80*	*p85*	*p90*	*p95*
Overall	451	75.0	49.5	56.4	64.6	73.9	85.1	98.9	115.7	138.5	173.2	232.1
(95% CI)		(57.3-104.6)	(27.8-67.8)	(33.8-76.1)	(41.0-86.5)	(49.5-97.5)	(59.0-111.6)	(69.9-133.5)	(82.9-161.2)	(97.8-200.1)	(120.9-262.3)	(165.0-379.7)
Fisher	138	98.2	64.7	74.3	85.2	97.9	113.2	130.4	154.1	184.1	229.2	305
(95% CI)		(66.3-158.3)	(32.8-106.5)	(38.6-121.0)	(45.9-137.9)	(54.8-159.1)	(65.1-184.2)	(78.2-218.7)	(91.1-257.7)	(112.9-316.1)	(141.4-401.6)	(196.7-540.3)

Table 14. Nez Perce Tribe. Distribution of the usual fish consumption (species Group 2) based on the 24-hour recalls. Estimated by the NCI method.

Group	*N*	*mean*	*p50*	*p55*	*p60*	*p65*	*p70*	*p75*	*p80*	*p85*	*p90*	*p95*
Overall	**446**	**66.5**	**36.0**	**42.1**	**49.5**	**58.0**	**68.7**	**81.7**	**98.2**	**121.8**	**159.4**	**233.9**
Documented fisher												
Fisher	138	98.4	55.2	64.8	75.4	86.3	101.8	121.9	146.9	181.5	238.6	345.0
Non-fisher	308	55.6	32.0	37.0	43.2	50.8	59.4	70.6	84.1	102.2	132.0	189.5
Gender												
Men	240	79.4	44.0	51.4	60.1	70.3	81.8	96.4	116.7	144.6	190.4	277.1
Women	206	55.0	29.0	34.0	39.8	47.5	56.3	67.9	82.7	102.8	135.6	198.0
ZIP Code												
83540	326	65.5	34.7	40.6	48.2	56.7	67.0	80.2	97.0	120.7	158.4	232.3
83536	38	83.7	46.6	54.8	63.8	74.8	88.9	104.3	129.6	162.4	219.2	301.5
83501	27	64.0	41.6	48.0	54.3	64.6	75.6	87.6	104.8	123.3	150.6	197.4
NP Other	55	63.0	30.2	36.4	43.0	51.3	60.0	72.2	87.9	112.8	150.0	231.3
Age												
18-29	61	76.9	49.4	56.6	64.2	72.5	82.5	93.7	108.4	130.3	167.0	249.4
30-39	94	83.7	53.1	61.0	69.2	79.0	90.4	104.0	122.5	147.6	189.0	262.8
40-49	115	65.1	43.6	48.9	54.9	62.5	71.1	81.7	95.0	114.2	142.8	196.6
50-59	88	55.2	33.8	38.3	43.6	49.9	57.7	67.5	80.4	96.9	122.1	173.0
60+	88	50.4	31.7	36.1	41.0	47.0	54.4	63.4	73.5	89.3	111.6	153.9

[SBT]

Table 12. Shoshone-Bannock Tribes. Distribution of the usual fish consumption (species Group 1) based on the 24-hour recalls. Estimated by the NCI method.

Group	*N*	*mean*	*p50*	*p55*	*p60*	*p65*	*p70*	*p75*	*p80*	*p85*	*p90*	*p95*
Overall	**226**	**34.9**	**14.9**	**18.3**	**22.3**	**27.6**	**33.7**	**41.9**	**53.4**	**69.2**	**94.5**	**140.9**
Documented fisher												
Fisher	134	42.4	20.0	24.4	29.7	35.9	43.6	53.6	67.0	84.6	114.3	163.6
Non-fisher	92	33.9	14.4	17.6	21.5	26.6	32.7	40.4	51.6	67.1	91.8	138.3
Gender												
Men	143	38.1	15.7	20.0	25.4	30.8	37.5	46.7	58.3	76.5	103.8	158.3
Women	83	32.2	14.4	17.3	20.6	25.2	31.1	38.3	48.6	62.3	85.6	126.8
ZIP Code												
83203	207	29.9	12.7	15.4	19.0	23.1	28.3	35.3	44.0	57.4	79.2	121.1
SB Other	19	59.2	33.4	40.0	47.8	56.6	67.7	79.5	96.9	118.7	151.0	209.7
Age												
18-29	36	24.3	7.6	9.1	10.9	13.6	17.6	23.8	31.3	42.5	62.9	110.2
30-39	39	44.6	25.6	30.2	35.2	40.7	48.9	57.9	70.9	88.2	113.4	159.0
40-49	51	51.7	23.2	28.2	34.5	42.5	53.7	67.1	85.6	108.6	147.4	202.5
50-59	48	31.8	14.0	17.3	20.7	25.5	32.2	40.6	52.1	65.6	88.9	125.8
60+	52	26.8	14.6	17.0	20.6	24.7	29.7	34.4	42.1	51.9	67.8	90.7

Table 13. Shoshone-Bannock Tribes. Distribution of the usual fish consumption (species Group 1) and their 95% confidence intervals based on the 24-hour recalls. Estimated by the NCI method.

	N	*mean*	*p50*	*p55*	*p60*	*p65*	*p70*	*p75*	*p80*	*p85*	*p90*	*p95*
Overall												
	226	34.9	14.9	18.3	22.3	27.6	33.7	41.9	53.4	69.2	94.5	140.9
(95% CI)		(20.6-66.2)	(3.4-28.9)	(4.7-33.4)	(6.9-39.8)	(9.3-48.8)	(13.1-62.0)	(18.0-80.2)	(25.4-105.8)	(35.6-140.2)	(52.6-199.8)	(82.0-312.9)
Fisher												
	134	42.4	20	24.4	29.7	35.9	43.6	53.6	67	84.6	114.3	163.6
(95% CI)		(23.7-84.6)	(7.3-39.1)	(9.3-46.9)	(12.2-55.8)	(15.7-68.3)	(20.5-81.8)	(27.1-104.5)	(34.7-132.4)	(43.4-174.5)	(56.6-238.3)	(83.6-376.2)

Table 14. Shoshone-Bannock Tribes. Distribution of the usual fish consumption (species Group 2) based on the 24-hour recalls. Estimated by the NCI method.

Group	*N*	*mean*	*p50*	*p55*	*p60*	*p65*	*p70*	*p75*	*p80*	*p85*	*p90*	*p95*
Overall	**225**	**18.6**	**6.5**	**8.0**	**10.0**	**12.5**	**15.6**	**20.0**	**25.6**	**34.1**	**48.9**	**80.0**
Documented fisher												
Fisher	134	23.3	10.2	12.5	15.4	18.8	22.8	28.0	35.3	45.5	61.5	92.6
Non-fisher	91	17.8	6.3	7.7	9.6	12.1	15.0	19.0	24.5	32.8	46.6	76.8
Gender												
Men	143	18.0	5.5	6.9	8.9	11.2	14.2	18.7	24.7	33.9	49.6	79.4
Women	82	19.5	6.9	8.4	10.4	13.1	16.2	20.2	25.6	34.1	48.2	84.3
ZIP Code												
83203	206	15.8	5.6	6.9	8.4	10.4	12.8	16.3	20.8	28.0	39.7	67.2
SB Other	19	34.1	14.3	19.2	23.9	28.4	34.5	42.1	53.7	67.4	90.2	130.7
Age												
18-29	36	1.3	0.4	0.5	0.6	0.8	1.0	1.3	1.7	2.2	3.1	5.4
30-39	39	36.5	19.8	23.0	27.4	33.1	38.9	46.7	56.8	70.7	93.0	136.3
40-49	51	50.9	19.8	25.9	33.9	42.7	53.6	65.4	81.0	102.8	140.9	203.0
50-59	48	12.6	2.6	3.8	5.9	8.5	11.8	15.7	21.1	27.0	37.5	55.2
60+	51	13.1	7.5	8.8	10.3	12.4	14.5	17.0	20.2	24.7	31.9	45.1

6.10 Quality Checking—NCI Method

[BOTH]
Some quality checks were carried out to determine if certain assumptions of the NCI method were met (see Section 5.23.3).

In order to check the NCI model results, certain distributions were examined to determine if they were similar to a normal ("bell-shaped") distribution—a requirement of the NCI methodology. The daily consumption rates were raised to an exponent power (lambda) prior to this particular assessment. The contractors examined the distribution of person-means (the mean for a respondent using only their power-transformed consumption on their one or two 24-hour recall days with non-zero fish consumption—if they had any such days). The contractors also examined the distribution of within-person residuals. These residuals are the difference of a respondent's power-transformed consumption on a 24-hour recall day from the mean of the two power-transformed values for respondents with two non-zero fish consumption days. These distributions of power-transformed values or residuals should appear approximately normal.

For several demographic subgroups the naïve mean (calculated without the NCI method but using survey weighting) was compared to the mean calculated from the NCI method. The naïve mean was compared to the NCI-method mean of: 1) the probability of consuming on a random day, and 2) the mean consumption amount, conditional on a day having some fish consumption.

The first quality check examined the distribution of the person-means and within-person residuals. The NCI models for species Groups 1 and 2 estimated a model lambda of 0.29 and 0.41, respectively, as powers for transformations that result in a distribution closest to the normal distribution. As both powers are close to the third root (lambda = 0.33), the contractors transformed the positive amounts of these consumptions of these species groups by taking the 3rd (cubic) root of the amounts. The distributions of the transformed person-means and the within-person residuals were then examined. The histograms of these distributions are shown in Appendix Figure E15 (Group 1) and Figure E16 (Group 2) and are, upon visual inspection, relatively close to the normal distribution.

In the second quality check, naïve and NCI method estimated consumption probabilities and means of positive consumption were compared. The comparisons were carried out within groups defined by the NCI model covariates are shown in Appendix Figures E17-R21. The covariates included the presence on the fishers list (Figure E17), gender (Figure E18), ZIP code (Figure E19), age (Figure E20) and the FFQ decile (Figure E21).

For all covariates, the naïve and NCI approaches revealed similar patterns of consumption probability and mean consumption amount across the different groups (e.g., the fishers and male consumption are estimated to be higher than their complementary population groups by all approaches). The forms of the naïve approach that utilized both interviews, however, tended to be higher than the NCI probabilities and means. This difference can be attributed to the difference between the first and the second interview (see Appendix Table E5 for the second interview coefficients in the NCI model). The means for the naïve approach that utilized only the first interview were slightly higher compared to the NCI means. This difference was expected

because the second 24-hour recall mean consumption (from a naïve, survey-weighted analysis) was somewhat higher than the first 24-hour recall mean (again, naïve). This systematic difference was addressed during the NCI analysis by keying the overall mean to the first 24-hour interview recall mean, a practice recommended by NCI staff (personal communication from Kevin Dodd to Moni Neradilek on June 22, 2015) based on 1st interview–2nd interview differences in mean consumption found in other dietary surveys.

An additional reason that the naïve means differed somewhat from the NCI method means is that the naïve approach does not account for the weekday-weekend differences. Specifically, the consumption amounts tended to be lower on the weekend than the weekdays and the weekend interviews were under-represented in the sample compared to equal representation of the seven days of the week (this is not unexpected as the interviewers were not instructed to achieve a specific ratio of weekday and weekend interviews). About 30% of the 24-hour recall interviews represented a weekend day versus 43% expected ([3 days]/[7 days] = 43%).). The excess of higher-consumption weekdays in the 24-hour interview data was addressed and adjusted in the NCI method analysis, yielding a lower NCI mean than the naïve mean.

As an additional quality check, the calculations of the estimates of the species Group 1 distribution (mean and percentiles) from the NCI method were also recomputed by NCI staff (personal communication from Kevin Dodd to Moni Neradilek on July 2, 2015). The re-computed mean and percentiles for species Group 1 were all within 0.4% of the contractors' estimates for the Nez Perce Tribe and within 0.9% for the Shoshone-Bannock Tribes.

6.11 Sensitivity Analyses—NCI Model

[BOTH]
We carried out a number of sensitivity analyses to understand the impact of various modeling choices on the estimated means and percentiles. Detailed results of the sensitivity analyses are presented in Appendix Tables E7-E17. All of the analyses in this section refer to comparisons of means and percentiles when models with different specifications are run using the NCI method.

Model with log_{10} FFQ replacing the 3rd root of the FFQ consumption rate. Compared to the final model, the change in this one FFQ variable as a covariate in the model had the following effect. The means for Group 1 species for NPT and SBT were 0.8% higher and 2.6% lower, respectively, when adjusted for log_{10} FFQ rather than the cube root of FFQ (Table E7). The corresponding 95th percentiles were 8.3% higher and 0.4% lower, respectively. The differences in means and the 95th percentiles between the two models were mostly small (<5%) for specific subgroups. Somewhat larger differences (10–30%) were present for some of the 95th percentiles, for the SBT mean for males, for the 18–29 age group and for the 60+ age group. Differences in Group 2 means and 95th percentiles from the two different FFQ specifications were even smaller than the differences for Group 1. Compared to the final model, the overall Group 2 means for NPT and SBT were 0.2% and 1.2% higher, respectively, when adjusted for log_{10} FFQ (Table E8). The corresponding 95th percentiles were 3.3% lower and 1.9% higher, respectively. All Group 2 differences in mean and percentile estimates for population subgroups were less than 13% of the estimate from the final model using the cube root of FFQ.

Model with no weekend adjustment. Estimated means and 95th percentiles for Groups 1 and 2 were only slightly affected by presence or absence of the weekend adjustment (Tables E9 and E10). Most of the estimates tended to increase when the weekend adjustment was not made, but the differences were small (<7%, except for Group 2 estimates for the SBT age group 50–59, which had approximately a 10% difference).

Model with no sequence effect adjustment. The final NCI models adjusted the estimated consumption for the sequence of the interviews, calibrating the 2nd interview consumptions to correspond to the 1st interview consumptions. To investigate the impact of this adjustment on the estimated distribution of fish consumption NCI models *without* this adjustment were considered. Estimated means and 95th percentiles for Groups 1 and 2 increased by 10–40% when the interview sequence was not addressed (Tables E11 and E12). Compared to the final model, the overall Group 1 means for NPT and SBT were 22.5% and 26.1% higher, respectively. The corresponding 95th percentiles were 13.8% and 22.3% higher, respectively. The overall Group 2 means for NPT and SBT were 24.4% and 30.1% higher, respectively. The corresponding 95th percentiles were 19.2% and 25.3% higher, respectively. This increase can be attributed to the higher mean consumption rate reported on the 2nd interview.

Model with no correlation between consumption probability and consumed amount. Estimated means and 95th percentiles for group 1 and 2 were almost identical when the NCI model ignored the correlation between the probability of consuming on a random day and consumption amount (Tables E13 and E14). All estimates of means and 95th percentiles were within 0.2% of the final model estimates for group 1 species consumption and within 3.9% for group 2 consumption.

Model fit only to the NPT data. Compared to the NPT mean and percentile estimates from the final model (using both NPT and SBT data), the Group 1 species mean and 95th percentile from the model using only NPT data were 5.4% lower and 9.6% higher, respectively (Table E15). In estimates for population subgroups, species Group 1 means from the NPT-only model were 3.0–8.4% lower and the 95th percentiles were 3.8–19.3% higher. The species Group 2 estimated mean and 95th percentile for the NPT population were 12.7% and 19.3% lower, respectively, when the model was fitted only to the NPT data (Table E16). In population subgroups, Group 2 means from the NPT-only model were 9.9–16.8% lower and the 95th percentiles were 5.6–23.6% lower.

Simpler model for Group 1. The simpler model for Group 1 consumption—a model which included only the covariates for tribe, the 3rd root of the FFQ rate and the tribe by the 3rd root of the FFQ interaction—had a relatively small effect on the estimated means and 95th percentiles compared to the final model (Table E17). In most cases the estimates from the simpler model differed from the final model estimates by <5%, and all of them differed by <15%.

In summary, the different sensitivity analyses showed the impact of the different modeling choices on the NCI model estimates. For most estimates of mean and the 95th percentile 1.) the use of log FFQ as covariate, 2.) the absence of the weekend adjustment, 3.) the use of no correlation between consumption probability and consumed amount and 4.) a simpler model for group 1 resulted in <5% difference in the estimates (compared to the final model). The estimated means and 95th percentiles for NPT changed up to 23.6% when the model was fit only to the

NPT data. When the model did not adjust for the interview sequence the estimates of the mean and the 95th percentile increased by 10-40% (compared to the final model).

6.12 Comparison of FFQ rates to 24-Hour Rates

[BOTH]
The estimated distributions of the 24-hour rates from the NCI method were limited to Group 1 and Group 2 species due to the very low number of double-hits for the other species groups considered. The naïve (survey-weighted) means for these two species groups has been calculated. These means can be compared to the corresponding means from the FFQ rate analysis. Under the assumption of a steady state of consumption rates over time (including the assumption of a steady state of the probability of consuming fish on a random day) and accurate reporting of fish consumption from all respondents' memories, the naïve means have the same expected value as the FFQ means. In addition, the mean consumption rate from the formal NCI method analysis for a given species group should agree well with the FFQ and naïve means, if the underlying NCI model is the correct model for the population and species groups being considered. Since the various assumptions would usually be only approximately correct, the contractors looked for approximate agreement of means. They also calculated the mean for 24-hour rates for a larger collection of species groups using the standard survey-weighted, naïve method. Some estimated means, 95th percentiles and ratios are presented in Table 15. Because the naïve approach does not adjust for the interview sequence and weekend vs. weekday effects, the naïve 24-hour means for Groups 1 and 2 were, as expected, larger than their NCI method counterparts.

[NPT]
The naïve 24-hour mean for Group 1 (estimated by the NCI method) was 61% of the corresponding mean estimated from the FFQ while the 95th percentile estimated from the 24-hour data was 53% of the FFQ estimate. The NCI-estimated Group 2 mean and the 95th percentile were 64% and 71% of the FFQ values, respectively. The means were also lower in the 24-hour data for other species groups as shown by the ratio of the naïve 24-hour mean and the FFQ mean. Most of the species had ratios between 0.33 and 0.88 (the mean of the Group 7 species consumption was 0.0 but was based on only two consumers of this species). It is obvious that the two survey methodologies are not in agreement in their estimates of the consumption rate distributions. These findings are considered further in the discussion section.

[SBT]
The naïve 24-hour mean for Group 1 (estimated by the NCI method) was 22% of the corresponding mean estimated from the FFQ while the 95th percentile estimated from the 24-hour data was 23% of the FFQ estimate. The NCI-estimated Group 2 mean and the 95th percentile were 17% and 19% of the FFQ values, respectively. The means were also lower in the 24-hour data for other species groups as shown by the ratio of the naïve 24-hour mean and the FFQ mean. It is obvious that the two survey methodologies are not in agreement in their

estimates of the consumption rate distributions. Most of the species had ratios between 0.02 and 0.33[16]. These findings are considered further in the discussion section.

[16] [SBT]The naïve 24-hour mean of the group 7 species consumption rate was zero, but this value was based on only two consumers of this species group (determined as consumers from their FFQ responses). These two consumers happened not to have consumed these species on their 24-hour recall days, resulting in a naïve mean of zero g/day.

[NPT]

Table 15. Nez Perce Tribe. Estimated means and 95th percentiles of consumption by species group and estimation method.

		Mean								95th percentile		
		24h					FFQ	Ratio		24h	FFQ	Ratio
Species group	*N*	*Mean (naïve method)*	*Mean (NCI method)*	*#>0*	*# 1 hit*	*# 2 hit*	*Mean*	*24h (naïve) /FFQ*	*24h (NCI) /FFQ*	*p95 (NCI method)*	*p95*	*NCI /FFQ*
Group 1: All Fish	451	93.9	75.0	179	136	43	123.3	0.76	0.61	232.1	437.0	0.53
Group 2: Near Coastal/Estuarine/freshwater/anadromous	446	81.4	66.5	150	117	33	103.9	0.78	0.64	233.9	327.5	0.71
Group 3: All salmon/steelhead	446	69.1		126	99	27	78.9	0.88			247.3	
Group 4: Resident trout	136	4.8		2	2	0	13.5	0.36			56.9	
Group 5: Other freshwater finfish and shellfish	150	4.7		4	4	0	14.3	0.33			75.9	
Group 6: Marine finfish and shellfish	308	31.4		65	62	3	51.1	0.61			155.4	
Group 7: Unspecified finfish or shellfish species	2	0.0		0	0	0	8.1	0.00			12.2	

#>0 = number of consumers with at least point positive 24h recall,
 # 1 hit = number of consumers with one positive 24h recall
 # 2 hit = number of consumers with two positive 24h recalls

[SBT]

Table 15. Shoshone-Bannock Tribes. Estimated means and 95th percentiles of consumption by species group and estimation method.

		Mean								95th percentile		
		24h					FFQ	Ratio		24h	FFQ	Ratio
Species group	*N*	*Mean (naïve method)*	*Mean (NCI method)*	*#>0*	*# 1 hit*	*# 2 hit*	*Mean*	*24h (naïve) /FFQ*	*24h (NCI) /FFQ*	*p95 (NCI method)*	*p95*	*NCI /FFQ*
Group 1: All Fish	226	43.3	34.5	56	48	8	158.5	0.27	0.22	140.9	603.4	0.23
Group 2: Near Coastal/Estuarine/freshwater/anadromous	225	25.9	18.6	31	28	3	110.7	0.23	0.17	80.0	427.1	0.19
Group 3: All salmon/steelhead	215	9.1		14	12	2	47.6	0.19			233.1	
Group 4: Resident trout	130	4.4		3	3	0	22.1	0.20			68.3	
Group 5: Other freshwater finfish and shellfish	97	0.2		2	2	0	11.2	0.02			43.5	
Group 6: Marine finfish and shellfish	222	32.8		40	35	5	98.8	0.33			402.6	
Group 7: Unspecified finfish or shellfish species	2	0.0		0	0	0	1.8	0.00			2.8	

#>0 = number of consumers with at least point positive 24h recall,
 # 1 hit = number of consumers with one positive 24h recall
 # 2 hit = number of consumers with two positive 24h recalls

6.13 Consumption at Special Events and Gatherings

[NPT]
The FFQ rates presented throughout this report include consumption at special events and gatherings, while this section summarizes, specifically, annual consumption at special events only. Consumers reported attending an average of 11.3 ± 15.1 special events or gatherings per year (median: 6). Of those who consumed at special events, their consumption at events was, on average, 11.5 ± 13.8% of their total consumption (median: 6.7%). Table 16 summarizes how often selected species and groups were consumed at special events and gatherings. Salmon and steelhead were the most common species consumed, with 96% of salmon/steelhead consumers eating from this species group at an average of 10.4 events per year. The large mean number of events per year where suckers and whitefish are consumed (19.3 events per year) is due to the fact that the seven members who consumed these two species at special events attended more than twice the number events per year than the overall average for all consumers (28.9 vs. 11.3 events per year).

Table 16. Nez Perce Tribe. Frequency of consumption at special events and gatherings for selected species and groups. Does not include consumption outside of special events and gatherings. Estimates are weighted.

	Species or Species Group			
	Salmon and Steelhead	**Resident Trout**	**Sturgeon**	**Suckers and Whitefish**
No. of consumers (based on the FFQ)	446	136	51	28
% who consume from the species or species group at special events	95.6%	17.5%	45.2%	29.4%
Events per year where species or species group is consumed*	10.4 ± 14.5	6.8 ± 9.1	8.1 ± 10.7	19.3 ± 17.4

*Values are mean ± SD from those who consume at special events.

[SBT]
The FFQ rates presented throughout this report include consumption at special events and gatherings, while this section summarizes, specifically, annual consumption at special events only. Consumers reported attending an average of 13.5 ± 19.4 events per year (median: 6.5). Their consumption at special events was, on average, 8.7 ± 11.1% of their total consumption (median: 4.0%). Table 16 summarizes how often selected species and groups were consumed at special events and gatherings. Salmon and steelhead were the most common species consumed, with 60% of salmon/steelhead consumers eating from this species group at an average of 8.8 events per year.

Table 16. Shoshone-Bannock Tribes. Frequency of consumption at special events and gatherings for selected species and groups. Does not include consumption outside of special events and gatherings. Estimates are weighted.

	Species or Species Group			
	Salmon and Steelhead	**Resident Trout**	**Sturgeon**	**Suckers and Whitefish**
No. of consumers (based on the FFQ)	215	130	4	10
% who consume from the species or species group at special events	59.6%	15.2%	0.0%	0.0%
Events per year where species or species group is consumed*	8.8 ± 20.1	5.1 ± 7.3	-	-

*Values are mean ± SD from those who consume at special events.

6.14 Fish Parts Eaten, Preparation Methods and Sources

[BOTH]
The percent of the time skin, eggs and the head, bones and/or other organs were consumed are summarized in Table 17. The skin was commonly consumed for salmon/steelhead and resident trout while the other parts were much less frequently consumed for any species group.

[NPT]
Table 17. Nez Perce Tribe. Percent of the time other fish parts were consumed for selected species and species groups. Consumers only*. Estimates are weighted.

	Species or Species Group			
Item	**Salmon and Steelhead**	**Resident Trout**	**Sturgeon**	**Suckers and Whitefish**
Skin	44.8 ± 47.7% (418)	36.3 ± 46.1% (122)	12.1 ± 29.8% (44)	7.8 ± 25.6% (24)
Eggs	2.2 ± 12.3% (309)**	2.2 ± 14.4% (117)	6.9 ± 22.1% (42)	0.4 ± 2.1% (20)
Head, bone and/or organs	3.9 ± 14.9% (309)**	6.4 ± 22.2% (117)	1.8 ± 11.9% (42)	10.0 ± 29.2% (20)

Values are mean ± SD; (sample size). Those who did not did not report a percentage value are excluded from calculation of the statistics in the given cell, e.g., consumption of sturgeon eggs.
Note: Missing values for eggs and head/bones/organs were interpreted as 0% if the respondent did not choose "Not applicable" or "Don't know or refused";
*Consumer status determined based on annual consumption reported in the FFQ;
**One interviewer frequently entered "Not applicable" to the question about consuming salmon or steelhead eggs, head, bone and other organs, contributing to a large number of missing values for these cells.

[SBT]

Table 17. Shoshone-Bannock Tribes. Percent of the time other fish parts were consumed for selected species and species groups. Consumers only*. Estimates are weighted.

	Species or Species Group			
Item	**Salmon and Steelhead**	**Resident Trout**	**Sturgeon**	**Suckers and Whitefish**
Skin	33.3 ± 41.9% (184)	44.7 ± 44.5% (105)	0.0 ± 0.0% (1)	0.0 ± 0.0% (1)
Eggs	0.7 ± 5.7% (178)	0.2 ± 4.4% (97)	0.0 ± 0.0% (2)	33.9 ± 49.9% (3)
Head, bone and/or organs	3.6 ± 16.6% (178)	2.6 ± 12.4% (97)	0.0 ± 0.0% (2)	52.6 ± 38.6% (3)

Values are mean ± SD (no.); (sample size). Those who did not did not report a percentage value are excluded from calculation of the statistics in the given cell, e.g., consumption of sturgeon eggs.
Note: Missing values for eggs and head/bones/organs were interpreted as 0% if the respondent did not choose "Not applicable" or "Don't know or refused.";
*Consumer status determined based on annual consumption reported in the FFQ.

[NPT]

Table 18 shows the percent of the time different preparation methods were used. Baked or broiled was a common preparation for all listed species (mean: 45.5–62.8% of the time, depending on the species). Smoking was also common for salmon/steelhead (mean: 19.6% of the time) and sturgeon (mean: 28.8% of the time). Dried or use in soups were uncommon (mean <5% for each listed species).

Table 18. Nez Perce Tribe. Percent of the time different preparation methods were used for selected species and species groups. Consumers only*. Estimates are weighted.

	Species or Species Group			
Method	**Salmon and Steelhead (N=445)**	**Resident Trout (N=131)**	**Sturgeon (N=50)**	**Suckers and Whitefish (N=24)**
Baked or broiled	62.8 ± 27.8%	45.5 ± 45.2%	45.6 ± 45.0%	46.2 ± 47.0%
Smoked	19.6 ± 19.8%	4.0 ± 13.5%	28.8 ± 38.8%	0.0 ± 0.0%
Dried	3.9 ± 8.2%	0.2 ± 1.8%	0.9 ± 3.9%	0.7 ± 4.1%
In a soup	2.0 ± 5.8%	0.5 ± 4.3%	2.2 ± 5.6%	4.5 ± 13.2%
Other	11.7 ± 22.7%	49.8 ± 47.1%	22.4 ± 38.2%	48.6 ± 46.8%

Values are mean ± SD;
Note: Missing values for any preparation method were interpreted as 0% if the total of non-missing values was 100%;
*Consumer status determined based on annual consumption reported in the FFQ. Those who did not report any percentage values for a specific species or species group were excluded from the corresponding column;
**Grilled was the most common "Other" preparation method for salmon and steelhead while fried was the most common method for resident trout, sturgeon, suckers and whitefish.

[SBT]
Table 18 shows the percent of the time different preparation methods were used. Baked or broiled was a common preparation for salmon/steelhead (mean: 59.9% of the time) and resident trout (mean: 40.9% of the time). Dried or in soups were uncommon (mean <3% for salmon/steelhead, resident trout and sturgeon and 24.4% for suckers and whitefish, which had four consumers).

Table 18. Shoshone-Bannock Tribes. Percent of the time different preparation methods were used for selected species and species groups. Consumers only*. Estimates are weighted.

	Species or Species Group			
Method	**Salmon and Steelhead (N=214)**	**Resident Trout (N=129)**	**Sturgeon (N=3)**	**Suckers and Whitefish (N=4)**
Baked or broiled	59.9 ± 36.7%	40.9 ± 41.8%	7.0 ± 29.5%	24.4 ± 45.3%
Smoked	14.1 ± 24.4%	3.4 ± 15.7%	0.0 ± 0.0%	0.0 ± 0.0%
Dried	2.4 ± 11.5%	2.4 ± 14.1%	0.0 ± 0.0%	0.0 ± 0.0%
In a soup	0.5 ± 3.0%	0.0 ± 0.0%	0.0 ± 0.0%	24.4 ± 45.3%
Other**	23.1 ± 33.0%	53.3 ± 42.3%	93.0 ± 29.5%	51.2 ± 52.7%

Values are mean ± SD;
Note: Missing values for any preparation method were interpreted as 0% if the total of non-missing values was 100%;
*Consumer status determined based on annual consumption reported in the FFQ. Those who did not report any percentage values for a specific species or species group were excluded from the corresponding column;
**Fried was the most common "Other" preparation method for salmon and steelhead and resident trout; sturgeon were also grilled and fried and suckers and whitefish were boiled, grilled and fried.

[BOTH]
The percent of the time consumed fish were obtained from different sources is summarized in Table 19. Salmon/steelhead and resident trout were most often caught in Idaho waters at [NPT] 74.4% and 89.6% of the time on average, respectively. [SBT] 78.0% and 87.2% of the time on average, respectively.

[NPT]

Table 19. Nez Perce Tribe. Percent of the time selected species and species groups were consumed from different sources. Consumers only*. Estimates are weighted.

	Species or Species Group			
Variable	**Salmon and Steelhead (N=442)**	**Resident Trout (N=130)**	**Sturgeon (N=51)**	**Suckers and Whitefish (N=24)**
Bought from a store (grocery or market)	1.9 ± 9.5%	1.0 ± 9.7%	0.1 ± 0.7%	20.1 ± 31.4%
From a restaurant	1.3 ± 5.9%	1.7 ± 11.2%	4.7 ± 20.6%	18.4 ± 29.9%
Caught by you or someone else (in Idaho waters)	74.4 ± 31.3%	89.6 ± 26.8%	25.6 ± 40.1%	58.2 ± 46.3%
Caught by you or someone else (outside of Idaho)	21.8 ± 29.2%	6.9 ± 21.7%	64.4 ± 44.3%	3.3 ± 12.0%
Other	0.6 ± 5.9%	0.8 ± 9.0%	5.2 ± 22.5%	0.0 ± 0.0%

Values are mean ± SD;

Note: Missing values for any preparation method were interpreted as 0% if the total of non-missing values was 100%;

*Consumer status determined based on annual consumption reported in the FFQ. Those who did not report any percentage values for a specific species or species group were excluded from the corresponding column.

[SBT]

Table 19. Shoshone-Bannock Tribes. Percent of the time selected species and species groups were consumed from different sources. Consumers only*. Estimates are weighted.

	Species or Species Group			
Variable	**Salmon and Steelhead (N=213)**	**Resident Trout (N=128)**	**Sturgeon (N=3)**	**Suckers and Whitefish (N=4)**
Bought from a store (grocery or market)	10.5 ± 23.3%	1.2 ± 8.6%	0.0 ± 0.0%	0.0 ± 0.0%
From a restaurant	5.3 ± 13.5%	0.4 ± 4.1%	0.0 ± 0.0%	24.4 ± 45.3%
Caught by you or someone else (in Idaho waters)	78.0 ± 33.8%	87.2 ± 31.1%	0.0 ± 0.0%	50.0 ± 52.7%
Caught by you or someone else (outside of Idaho)	6.2 ± 21.4%	11.3 ± 30.1%	100.0 ± 0.0%	25.6 ± 46.0%
Other	0.0 ± 0.8%	0.0 ± 0.0%	0.0 ± 0.0%	0.0 ± 0.0%

Values are mean ± SD;

Notes: Missing values for any preparation method were interpreted as 0% if the total of non-missing values was 100%;

*Consumer status determined based on annual consumption reported in the FFQ. Those who did not report any percentage values for a specific species or species group were excluded from the corresponding column.

6.15 Fishing Activities

[NPT]
Based on the questionnaire responses, it is estimated that 61% of consumers took part in fishing activities over the past year. Figure 5 shows the mean number of times respondents went fishing each month. June had the highest fishing frequency, followed by July and then May. January and December had the lowest fishing frequencies. Table 20 summarizes overall fishing frequency and respondents' access to fishing gear and boats.

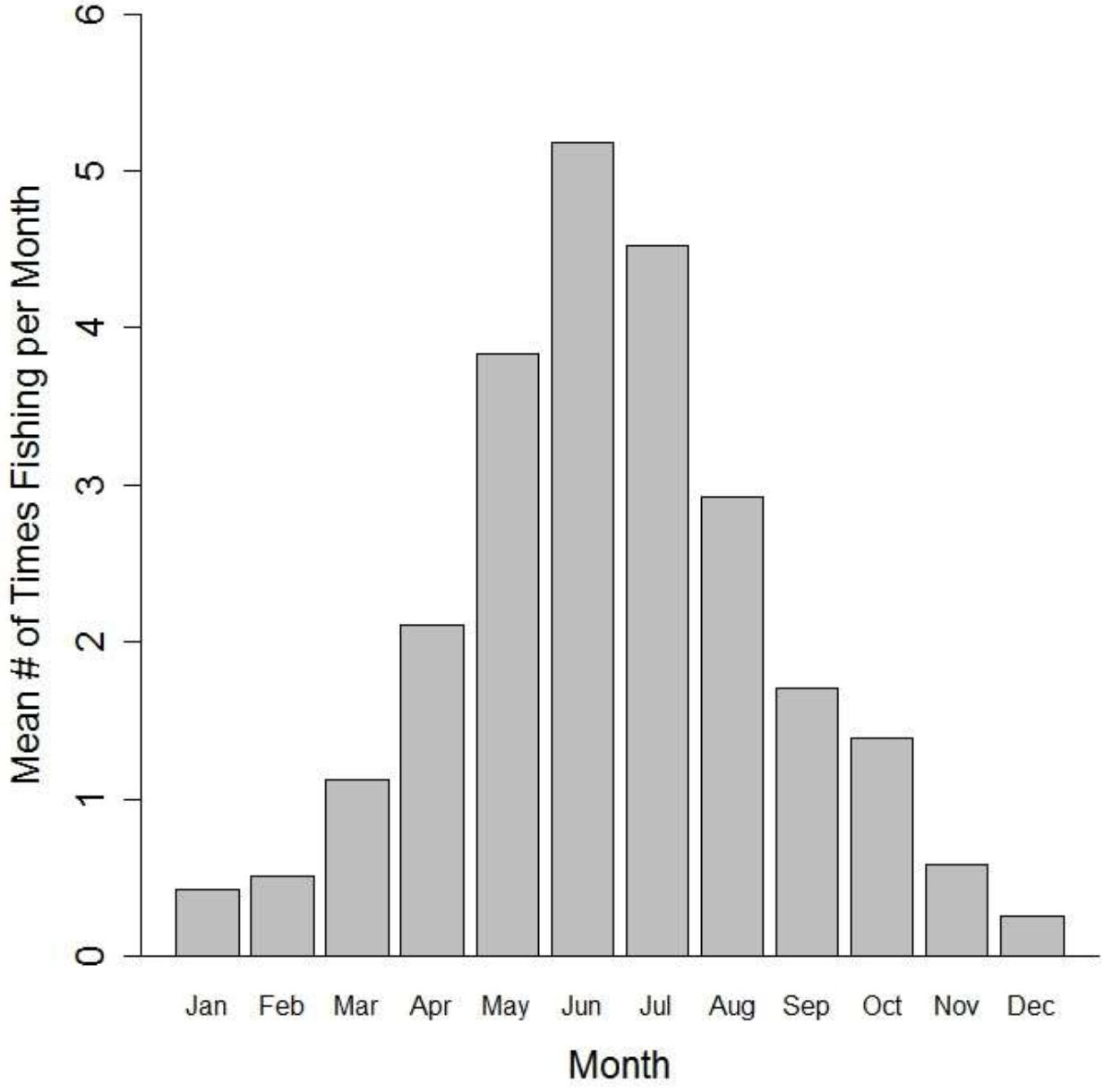

Figure 5. Nez Perce Tribe. Mean number of times respondents went fishing each month among the 283 respondents who reported fishing at least once. Estimates are weighted.

Table 20. Nez Perce Tribe. Fishing activities during the preceding year as reported by the 283 respondents who reported fishing at least once. Estimates are weighted.

Variable		% or Mean ± SD	No. Responded
Number of times went fishing		24.6 ± 35.1	283
Percent of fish harvested which were--	Kept	60.0 ± 24.7%	277
	Given to others	34.5 ± 22.2%	
	Sold	5.5 ± 16.5%	
Own or have access to fishing gear	Yes	97.1%	283
	No	2.9%	
Own or have access to a boat	Yes	34.3%	283
	No	65.7%	

[SBT]
Based on the questionnaire responses, it is estimated that 53% of consumers took part in fishing activities over the past year. Figure 5 shows the mean number of times respondents went fishing each month. June had the highest fishing frequency, followed by August and then June. January and December had the lowest fishing frequencies. Table 20 summarizes overall fishing frequency and respondents' access to fishing gear and boats.

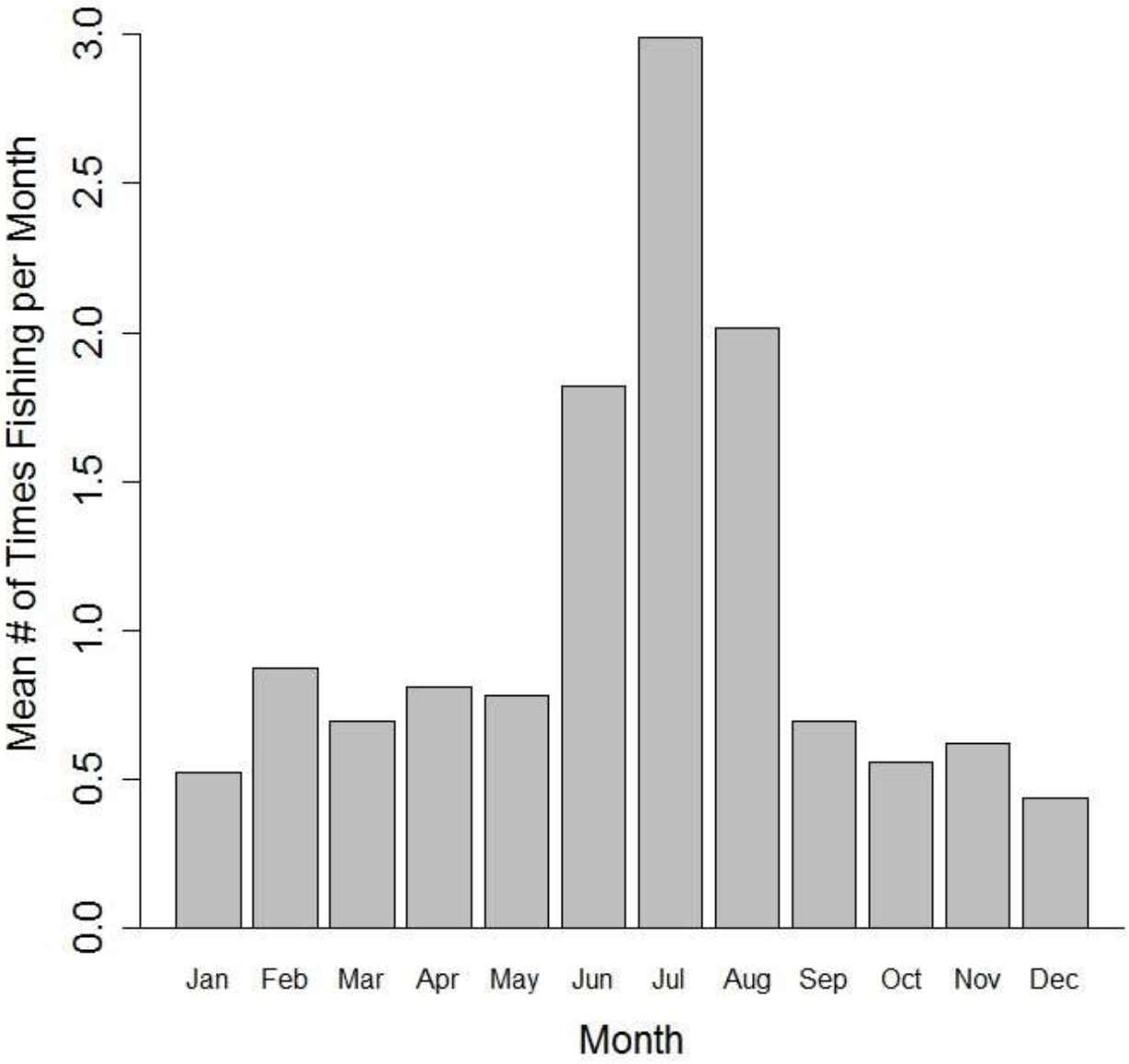

Figure 5. Shoshone-Bannock Tribes. Mean number of times respondents went fishing each month of the 143 who reported fishing at least once.

Table 20. Shoshone-Bannock Tribes. Fishing activities during the preceding year as reported by the 143 respondents who reported fishing at least once. Estimates are weighted.

Variable		% or Mean ± SD	No. Responded
Number of times went fishing		12.8 ± 15.6%	143
Percent of fish harvested which were--	Kept	73.9 ± 26.1%	141
	Given to others	26.1 ± 26.1%	
	Sold	0.0 ± 0.0%	
Own or have access to fishing gear	Yes	95.0%	143
	No	5.0%	
Own or have access to a boat	Yes	25.1%	143
	No	74.9%	

6.16 Changes in Consumption and Reasons

[NPT]
Table 21 summarizes reported changes in consumption and access to fish and fishing. Nearly all consumers believe that fish were/are very important in the Tribe's heritage and culture in the past (97.9%) and present (96.4%).

An estimated two-fifths of the consumers have experienced a change in fish consumption over time, and among those who have experienced the change, 49% experienced increased consumption and 47% experienced a decrease. A large proportion of the consumers (48%) have experienced a change in fishing access and, among those experiencing a change, less access to fishing (71%) far outweighed more access (25%). Similarly, 38% of consumers reported a change in fishing frequency, of which 30% reported an increase and 67% reported a decrease. Nearly all consumers want to increase consumption (45%) or maintain current levels of consumption of fish (55%).

Table 21. Nez Perce Tribe. Estimated consumption and fishing access changes in the eligible consumer population. Estimates are weighted.

Variable		%	No. Responded
Importance of fish in Tribe's heritage	Very important	97.9%	451
and culture, in the past	Somewhat important	2.0%	
	Not important	0.1%	
Importance of fish in Tribe's heritage	Very important	96.4%	450
and culture, in the present	Somewhat important	3.6%	
	Not important	0.0%	
Change in fish consumption over time	Yes	39.2%	451
	No	60.8%	
If so, how has consumption changed	Increased	48.9%	171
	Decreased	47.4%	
	Other	3.8%	
Change in access to fish and fishing over time	Yes	48.4%	427
	No	51.6%	
If so, how has access changed	More access	25.4%	201
	Less access	70.7%	
	Other change	3.9%	
Change in frequency of fishing	Yes	38.3%	441
	No	61.7%	
If so, how has fishing frequency changed	Increased	30.4%	164
	Decreased	67.1%	
	Other	2.5%	
Desired fish consumption in the future compared to now	Increase amount	45.2%	451
	Maintain amount	54.7%	
	Decrease amount	0.1%	

[SBT]
Table 21 summarizes reported changes in consumption and access to fish and fishing. The vast majority of consumers believe that fish were either very or somewhat important (90%) or somewhat important (6%) in the Tribes' heritage and culture in the past. The total percentage of consumers who believe that fish are either very or somewhat important to the Tribes' heritage and culture in the present was similar at 97%, while the percent who believe fish are very important in the present is 77%.

More than half (53%) of the consumers have experienced a change in fish consumption over time, and among those who have experienced the change, 50% experienced increased consumption and 47% experienced a decrease. A large proportion of the consumers (44%) have

experienced a change in fishing access, and, among those experiencing a change, less access to fishing (68%) far outweighed more access (20%). Similarly, 51% of consumers reported a change in fishing frequency, of which 14% reported an increase and 84% reported a decrease. Nearly all consumers want to increase consumption (47%) or maintain current levels of consumption of fish (52%).

Table 21. Shoshone-Bannock Tribes. Estimated consumption and fishing access changes in the eligible consumer population. Estimates are weighted.

Variable		%	No. Responded
Importance of fish in Tribes' heritage	Very important	90.2%	220
and culture, in the past	Somewhat important	6.4%	
	Not important	3.4%	
Importance of fish in Tribes' heritage	Very important	77.4%	221
and culture, in the present	Somewhat important	20.1%	
	Not important	2.5%	
Change in fish consumption over time	Yes	52.9%	226
	No	47.1%	
If so, how has consumption changed	Increased	49.5%	104
	Decreased	47.0%	
	Other	3.5%	
Change in access to fish and fishing over time	Yes	44.5%	216
	No	55.5%	
If so, how has access changed	More access	19.7%	114
	Less access	67.8%	
	Other change	12.5%	
Change in frequency of fishing	Yes	50.5%	219
	No	49.5%	
If so, how has fishing frequency changed	Increased	14.3%	115
	Decreased	83.6%	
	Other	2.1%	
Desired fish consumption in the future compared to now	Increase amount	47.4%	225
	Maintain amount	51.6%	
	Decrease amount	1.0%	

6.17 Re-Interviews

[NPT]
Thirty-one re-interviews were conducted between April 3 and June 12, 2015. The time between the first interview and the re-interview ranged from 28 days to 85 days (median 55 days). There

were 17 female respondents and 14 male respondents. Of the 31 respondents, 29 (94%) reported consuming Chinook during the re-interview. Of the 2 who did not report consuming Chinook during the re-interview, one did report consuming Chinook on the first interview (3 days per year). Of the 29 who reported consuming Chinook on the re-interview, on the first interview 23 also reported Chinook, three reported an unspecified salmon species only and three reported Coho salmon as the only salmon species. As the respondents were not always sure of the specific salmon species they consumed, these six instances of unspecified salmon species or Coho salmon reported on the first interview were assumed to be Chinook salmon for the purposes of comparing consumption frequencies between first and re-interviews.

Table 22 summarizes the responses to the first interview and re-interview. The mean (± SD) frequency of Chinook consumption on the first interview and re-interview was 30.7 ± 30.8 and 30.9 ± 38.9 portions/year, respectively, with an average difference of 0.2 ± 36 portions/year. The correlation in the number of portions per day between the first interview and re-interview was r = 0.57 (Spearman's correlation coefficient). The results were little changed when the one respondent with an imputed duration of their high consumption period was omitted (Spearman's r=0.60).

Respondents were asked in both interviews whether their overall fish consumption had changed. Of the 31 respondents, 20 (65%) gave the same response on both. Nine others reported a change in consumption (5 increased and 4 decreased) on the first interview but no change on the re-interview. Of the 9 respondents who reported a change in consumption on both interviews, 7 (78%) agreed on the direction of change. The number living in the household of the respondent was reported to be 4.1 ± 2.4 on the first interview and 4.5 ± 2.5 on the second (Spearman's r = 0.92).

Overall, the first and re-interview responses were consistent with either other, particularly in the summary means and percentages, though there were disagreements at the individual level. These results support the use of aggregate summaries of consumption.

Table 22. Nez Perce Tribe. Summary of FFQ interview and re-interview responses. All rows are based on all 31 respondents who completed both interviews. Summaries are unweighted.

	Interview	
Questionnaire Item	FFQ Interview	Re-Interview
Consumed Chinook salmon	96.8%	93.5%
Frequency of Chinook consumption*, portions/year	30.7 ± 30.8	30.9 ± 38.9
Overall fish consumption has changed over time	58.1%	35.5%
Overall fish consumption increased	32.3%	22.6%
Overall fish consumption decreased	25.8%	12.9%
Number living in respondent's household	4.1 ± 2.4	4.5 ± 2.5

Values are percentages or mean ± SD;
*Includes non-consumers as 0.

[SBT]
Thirty re-interviews were conducted between March 31 and May 19, 2015. The time between the first interview and the re-interview ranged from 28 days to 77 days (median 54 days). There

were 16 male respondents and 14 female respondents. Of the 30 respondents, 25 (83%) reported consuming Chinook during the re-interview. Of the 5 who did not report consuming Chinook during the re-interview, three did report consuming Chinook on the first interview (10, 12 and 84 days per year). Of the 25 who reported consuming Chinook on the re-interview, on the first interview, 24 also reported Chinook and one reported consuming pink salmon but no other salmon species. As the respondents were not always sure of the specific salmon species they consumed, As the respondents were not always sure of the specific salmon species they consumed, this instance of pink salmon reported on the first interview were assumed to be Chinook salmon for the purposes of comparing consumption frequencies between first and re-interviews.

Table 22 summarizes the responses to the first interview and re-interview. The mean ± SD frequency of Chinook consumption on the first interview and re-interview was 15.5 ± 18.0 and 19.7 ± 24.2 portions/year, respectively, with an average difference of 4.1 ± 28.8 portions/year. The correlation in the number of portions per day between the first interview and re-interview was r = 0.24 (Spearman's correlation coefficient).

Respondents were asked in both interviews whether their overall fish consumption had changed. Of the 30, 17 (57%) gave the same response on both. Eight others reported a change in consumption (1 increased and 7 decreased) on the first interview but no change on the re-interview. Five reported a change in consumption on the re-interview (3 increased and 2 decreased) but not on the first interview. Of the 4 who reported a change in consumption on both interviews, 3 (75%) agreed on the direction of the change. The number living the in household of the respondent was reported to be 3.6 ± 1.6 on the first interview and 3.8 ± 1.4 on the second (Spearman's r = 0.87).

Overall, the first and re-interview responses were consistent with either other, particularly in the summary means and percentages, though there were disagreements at the individual level. These results support the use of aggregate summaries of consumption.

Table 22. Shoshone-Bannock Tribes. Summary of FFQ interview and re-interview responses. All rows are based on all 30 respondents who completed both interviews. Summaries are unweighted.

	Interview	
Questionnaire Item	FFQ Interview	Re-Interview
Consumed Chinook salmon	93.3%	83.3%
Frequency of Chinook consumption*, portions/year	15.5 ± 18.0	19.7 ± 24.2
Overall fish consumption has changed over time	40.0%	30.0%
Overall fish consumption increased	6.7%	16.7%
Overall fish consumption decreased	33.3%	13.3%
Number living in respondent's household	3.6 ± 1.4	3.8 ± 1.6

Values are percentages or mean ± SD;
*Includes non-consumers as 0.

6.18 Reliability and Cooperation of Respondents—Interviewer's Assessment

[NPT]
Of the 452 completed first interviews, the duration ranged from 15 minutes to 131 minutes (mean ± SD: 59 ± 28 minutes). This excludes two implausible duration values. Sixteen percent were conducted at the respondent's home and 70% were conducted in private, without others present.

[SBT]
Of the 226 completed first interviews, the duration ranged from 15 minutes to 145 minutes (mean ± SD: 65 ± 17 minutes). Forty five percent were conducted at the respondent's home and 82% were conducted in private, without others present.

[BOTH]
Table 23 shows that the interviewers found only a very small fraction of respondents to be less than "highly reliable" or "generally reliable." Similarly, the interviewers found only a small fraction of respondents to be less than "very good" or "good" in their cooperation.

[NPT]
Table 23. Nez Perce Tribe. Descriptive summary of interviewers' ratings of respondents' cooperation and reliability during the first interview. Summaries are unweighted.

Variable		%	No.
Respondent's cooperation	Very good	88.2%	398
	Good	10.9%	49
	Fair	0.9%	4
	Poor	0.0%	0
Respondent's reliability	Highly reliable	80.7%	364
	Generally reliable	19.3%	87
	Questionable	0.0%	0
	Unreliable	0.0%	0

[SBT]
Table 23. Shoshone-Bannock Tribes. Descriptive summary of interviewers' ratings of respondents' cooperation and reliability during the first interview. Summaries are unweighted.

Variable		%	No.
Respondent's cooperation	Very good	86.7%	196
	Good	11.1%	25
	Fair	2.2%	5
	Poor	0.0%	0
Respondent's reliability	Highly reliable	84.1%	190
	Generally reliable	14.2%	32
	Questionable	1.3%	3
	Unreliable	0.4%	1

7.0 Discussion

7.1 Overview

[BOTH]
This fish consumption survey provides some unique information about fish consumption and fish harvesting by [NPT] a Tribe [SBT] Tribes [BOTH] residing in the Columbia River Basin. Two different sets of estimates of fish consumption rates are presented, each developed by a quite different methodology.

One set of rates is based on a food frequency questionnaire (FFQ), through which respondents provided information on their fish consumption over the past year. The information on frequency of consumption, portion sizes and the duration of certain consumption seasons has been combined to yield a consumption rate (g/day) for each respondent for each of the species they have consumed—the FFQ rates. Means and percentiles of the FFQ rate distribution have been presented in this report.

The second method of estimation of rates uses the respondents' answers about fish consumption during a 24-hour period ("yesterday") along with some plausible modeling assumptions (the NCI method) to come up with estimates (means and percentiles) that can be directly compared to those provided by the FFQ method. The NCI method does not provide estimates of rates for the individual respondents encountered in the survey. Rates from the NCI method have also been presented in this report.

The FFQ method's and NCI method's estimates of means and percentiles differ, and the truth is probably somewhere in between. This issue is discussed later in this section. Because the NCI and FFQ methods are quite different, a specific summary statistic from this population, such as a mean or a percentile, should be compared to a statistic computed with a similar methodology from another population in order to draw a valid comparative conclusion. The NCI-method statistics would usually be preferable when they are available (and if the sample size is sufficiently large to support the method), since the very limited information comparing the FFQ and 24-hour dietary recall methods shows that the 24-hour recall method provides energy and protein intake estimates closer to an accepted standard intake measure than the FFQ method (Haines et al, 2003). The NCI-method analysis may not be possible for consumption of narrowly defined fish groups or small sample sizes, as the requisite number of double hits would usually not be available. The FFQ approach is feasible for surveys with a much smaller sample size than that needed for the NCI method. While larger sample sizes provide more precise estimates from any method, the minimum size for assurance of feasibility of using the NCI method would usually start in the hundreds.

[NPT]
The fish consumption survey of the Nez Perce Tribe, based on a moderately low response rate (38%) to the survey—and one that has likely been addressed by use of survey weighting techniques—has a substantial fish consumption rate, with quite large consumption rates for a notable fraction of the population, whether the FFQ or NCI method rates are considered. As is shown in a later section of this discussion, the mean, median and 90^{th} and 95^{th} percentiles of FFQ

consumption rates for the Nez Perce Tribe are larger than those of the pooled CRITFC tribes, the only other inland Pacific Northwest tribes with documented FFQ consumption rates that can be used for comparison with inland tribes. The Nez Perce rates are also higher than that of the Tulalip and Squaxin Island Tribes, but lower than that of the Suquamish Tribe. All of the aforementioned tribes have access to Puget Sound fisheries resources, and the surveys for all of these tribes were conducted using some form of the FFQ method.

A contributing factor to the high fish consumption rates as compared to the CRITFC survey may be the difference in the abundance of anadromous fish particularly, and other fish species more generally, that were at lower levels in the 1990s and have been increasing to higher levels in the past decade or more, based on yearly counts of fish passages at Lower Granite Dam from the website of the Fish Passage Center (see www.fpc.org). The fish runs in recent years are larger, which would support more harvest opportunities, and therefore would be expected to support increased current consumption by Tribal members compared to the time of the CRITFC survey. However, the CRITFC study only included consumption of fish that might be harvested from the Columbia River Basin. The current survey examines consumption of all species of fish and shellfish. This difference in methodology also contributes to the higher FFQ rates observed in this survey relative to the rates in the CRITFC report.

Very few non-consumers of fish were encountered in the survey. Only nine out of 472 respondents reported non-consumption of fish (based on respondents who adequately completed the relevant portions of the questionnaire).

The Nez Perce Tribe has experienced changes in fish consumption rates and fishing activities, as documented by the survey. Among those who reported a change in access to fishing, many more reported less access (71%) than more access (25%), compared to an earlier time.

The tribal members and staff and Nez Perce Tribal Executive Committee contributed very significantly to the execution of this survey. Through advertising, offering of incentives (at the Tribe's own expense), opening special events and powwows to interviewing opportunities, conducting mailings to tribal members, and other forms of information and advertising, the Nez Perce came forward to substantially reverse what was a very challenging and difficult slow start to the survey. Thus, in addition to the quantitative findings in this report, the role of the Tribe and its governing body and staff should be considered a critical component in the planning of future tribal surveys. In addition, the development of individual rapport and mutual trust between individuals from the contractor's staff and those from the tribal staff was a critical component of the survey. The Tribe is a separate and distinct nation, and collaboration with this unique nation is something that involves mutual learning, both from the contractor's staff and the Tribe.

[SBT]

The fish consumption survey of the Shoshone-Bannock Tribes, based on a moderately low (42%) response rate to the survey—and one that has likely been addressed by use of survey weighting techniques—has a substantial fish consumption rate, with quite large consumption rates for a notable fraction of the population, whether the FFQ or NCI method rates are considered. As is shown in a later section of this discussion, the mean median and 90^{th} and 95^{th} FFQ percentiles of consumption for the Shoshone-Bannock Tribes are larger than the corresponding rates for the

four pooled CRITFC tribes, the only other inland Pacific Northwest tribes with documented consumption rates than can be used for comparison with inland tribes. In comparison to tribes with access to Puget Sound fisheries resources, the Shoshone-Bannock rates are also higher than that of the Tulalip and Squaxin Island Tribes, but lower than that of the Suquamish Tribe. The surveys for all of aforementioned tribes were conducted using some form of the FFQ method.

A contributing factor to the high fish consumption rates as compared to the CRITFC study may be the difference in the abundance of anadromous fish particularly, and other fish species more generally, that were at lower levels in the 1990s and have been increasing to higher levels in the past decade or more, based on yearly counts of fish passages at Lower Granite Dam from the website of the Fish Passage Center (see www.fpc.org). The fish runs in recent years are larger, which would support more harvest opportunities, and therefore would be expected to support increased current consumption by Tribal members compared to the time of the CRITFC survey. However, the CRITFC study only included consumption of fish that might be harvested from the Columbia River Basin. The current survey examines consumption of all species of fish and shellfish. This difference in methodology also contributes to the higher FFQ rates observed in this survey relative to the rates in the CRITFC report.

The Shoshone-Bannock Tribes have reported changes in fish consumption rates and fishing in this survey, with many more members reporting a decrease in access to fishing (68%) than an increase (20%).

The tribal members and staff and Shoshone-Bannock Tribal leadership (Fort Hall Business Council) contributed very significantly to the execution of this survey. Through advertising, offering of incentives (at the Tribes' own expense) and other forms of communication, the Shoshone-Bannock Tribes supported the survey. Thus, in addition to the quantitative findings in this report, the role of the Tribes and their governing body and staff should be considered a critical component in the planning of future tribal surveys. In addition, the development of individual rapport and mutual trust between individuals from the contractor's staff and those from the tribal staff was a critical component of the survey. The Tribes are a separate and distinct nation, and collaboration with this unique nation is something that involves mutual learning, both from the contractor's staff and the Tribes.

Non-consumers of fish constitute a moderately low percentage of the population as estimated from the survey. The estimated fish non-consumption rate in the tribal population is 20%. This percentage is based on respondents who adequately completed the relevant portions of the questionnaire and the analysis using appropriate statistical survey weights for each of the 31 non-consuming respondents and 238 consuming respondents.

7.2 Comparison of FFQ Rates to NCI Rates

[NPT]
The estimated naïve mean consumption rates (Groups 1 and 2) differed between the FFQ-based rates and the rates based on the first 24-hour recall, with the 24-hour mean rates being lower—76% to 78% as large as the FFQ means for Groups 1 and 2, respectively (Table 15). The difference was statistically significant for Group 1 species ($p < 0.01$) and marginally significant for Group 2 species ($p = 0.053$). The other species groups assessed (Groups 3-7) also had lower naïve 24-hour means than the FFQ means. It appears likely that the NCI-method rates are closer to the true fish consumption rates during the survey year.

The NCI method rates have the advantage that the data come from a less demanding exercise in memory and personal estimation than the FFQ data. The reported 24-hour consumption is tied to specific events that are very recent to the interview ("yesterday"). The NCI method, however, contains strong assumptions about the shape[17] of the distribution of usual consumption, and the fitted shape used to provide the NCI estimates may or may not fit well in the tails of the distribution. The upper tail of the distribution may not track the true distribution for very high-level consumers very well. Diagnostics and quality checks suggest that the NCI model fits the tribal data well overall, but there is no definitive methodology to check segments of the NCI method distributions, such as the upper tail of fish consumption rates, including the important and oft-cited 90th and 95th percentiles. It seems best to give more weight to the NCI estimates, but to also give some weight to the FFQ estimates, particularly for the highest and lowest percentiles. Also, an FFQ survey is the only method—using limited resources— for deriving the distribution of usual consumption (e.g., 'usual' over the course of a year) for species groups that do not have sufficient double hits available to support the NCI method. It is also the only method available for a fish consumption survey of limited sample size, for which only a handful—not 50—double hits may be expected.

[SBT]
The estimated mean consumption rate differed (and with statistical significance) between the FFQ-based rates and the rates based on the first 24-hour recall, with the 24-hour mean rates being lower (Table 15). The naïve 24-hour mean consumption rates of Group 1 and Group 2 species were 27% and 23% as large as the means from the FFQ method ($p < 0.01$ for both comparisons). The other species groups assessed (Groups 3-7) also had lower naïve 24-hour means than the FFQ means. It appears likely that—compared with the FFQ approach—the rates based on the NCI method are closer to the true fish consumption rates..

The NCI method rates have the advantage that the data come from a less demanding exercise in memory and personal estimation than the FFQ data. The reported 24-hour consumption is tied to specific events that are very recent to the interview (consumption occasions "yesterday"). The NCI method, however, has strong assumptions about the shape of the distribution[18] of usual consumption, and the fitted shape used to provide the NCI estimates may or may not fit well in the tails of the distribution. The upper tail of the distribution may not track the true distribution

[17] The NCI method assumes a certain family of shapes.
[18] The NCI method assumes a certain family of shapes.

for very high-level consumers very well. Diagnostics and quality checks suggest that the NCI model fits the tribal data well overall, but there is no definitive methodology to check portions of the NCI method distributions, such as the upper tail of fish consumption rates, including the important and oft-cited 90th and 95th percentiles. It seems best to give more weight to the NCI estimates, but to also give some weight to the FFQ estimates, particularly for the highest and lowest percentiles. Also, an FFQ survey is the only method—using limited resources— for deriving the distribution of usual consumption (e.g., 'usual' over the course of a year) for species groups that do not have sufficient double hits available to support the NCI method. It is also the only method available for a fish consumption survey of limited sample size, for which only a handful—not 50—double hits may be expected.

[BOTH]
Some factors—including those just discussed—that may help to explain the difference between the FFQ consumption rates and the rates from the NCI method include the following.

• **Chance**. The FFQ rates per respondent may correctly reflect their consumption over their past year, but, by chance, the days on which they were interviewed about their consumption 'yesterday' happened to selectively miss their days of actual fish consumption. Chance, may, indeed, explain part of the difference, but the difference in means and 95th percentiles between the two methodologies is statistically significant ($p < 0.05$), so only a part of the difference might be explained this way.

• **Memory and interpretation.** Both the FFQ and 24-hour recall responses require the respondents to exercise their memory and interpret their fish consumption behavior. The 24-hour recall is less challenging to memory than the FFQ. The 24-hour recall questions ask about what happened 'yesterday'; the FFQ asks about what happened over the course of 12 months before the present moment. The fish consumption occasions addressed by the 24-hour recall can be at most 48 hours old; e.g., consider a Monday 11:55 p.m. interview response of a person who ate fish at 12:05 a.m. on Sunday. The FFQ respondent is referring to an average that my not correspond to any events; e.g., a person who eats fish twice per week during every 2nd week would need to report an average frequency of once per week, a frequency which never happens during any single week. Whereas, the 24-hour recall asks for an inventory of fish-eating occasions on the preceding day—no averaging is involved. Similarly, the 24-hour recall asks for the portion size per eating occasion yesterday rather than for the FFQ's typical portion size during a year. Finally, the FFQ handles variation in consumption during the course of a year by allowing up to two periods of consumption—a high and low consumption period, if needed. The 24-hour recall simply records what happened throughout a single day

The 24-hour recall also may have memory error, including error in a) determining when 'yesterday' began and ended, b) forgetting items consumed yesterday, c) moving consumption from another day into 'yesterday' and d) errors in portions sizes or species consumed 'yesterday.'

Differences in frequency or portion-size reporting. This topic is also a memory issue, but it is worth considering it separately. It is possible that some of the components used to calculate fish consumption rates were misreported. The frequency of consumption of a species, the portion size

typically consumed or the duration of the high-consumption season may each or all have been reported with an upward or downward bias in the FFQ or the 24-hour (or both) segments of the interviews. An analysis carried out in association with a smaller dataset showed that the frequency of consumption of species reported in the FFQ segment of the interview predicted a greater number of single and double hits (for all species combined) than were observed in the two 24-hour recall segments of the interviews. Thus, respondents may have over-reported the frequencies of consumption of some or all species.

• **Reference period.** The collection of 'yesterdays' reported by the pool of respondents in the survey spans a period of approximately one year (12 months) corresponding to the duration of interviewing activity in the survey. The reference period for the fish consumption during the FFQ's preceding year spans almost two years (24 months), corresponding to the beginning of the preceding year for the first-interviewed respondent to the end of the preceding year (the interview day) for the last respondent to complete the FFQ segment of the interview. Thus, collectively for the pool of respondents, the two reference periods do not match. This appears not to be an important factor in influencing FFQ rates. In the analysis of seasonality described in Section 5.23.2, the calculated mean FFQ consumption rate did not appear to vary systematically month by month across the 12 months during which FFQ interviews occurred, which is consistent with (but does not prove) a consumption regimen that was not highly variable during the entire two-year reference period.

Modeling: tails of the distribution. As noted earlier, the rates based on the 24-hour recall and the NCI method may be more accurate in the middle of the distribution of usual consumption rates than in the upper or lower tails, including the important 95th percentile of consumption rates. Currently there is no way to verify the accuracy of different segments of the distribution of usual consumption rates provided by the NCI method. A fact about the NCI method modeling is good to bear in mind. The NCI model is fitted using all of the 24-hour data to determine one model, and the tails of the distribution of usual consumption are determined by and consistent with the entire distribution, including the central hump of the unimodal distribution. Every part of the distribution is affected by the data from every respondent, including those with low, medium or high consumption. With the FFQ data, however, the upper tail (and the lower tail) is determined by those with very high (or very low) consumption. One can have two FFQ distributions with exactly the same shape (percentile values) up to, say, the 90th percentile, but then one of the two distributions can continue with a long tail of very high consumption rates and the other distribution can continue with, say, consumption rates arbitrarily close to the 90th. percentile value That kind of 'independence' of the upper tail (or lower tail) cannot happen with the NCI model. The upper tail has to fall in line with the functional form determined by the entire dataset.

Among the considerations cited above—chance, memory, consumption frequency, portion size, reference period and modeling issues, none of them can, alone, be used to explain, without reasonable doubt, the difference in means and percentiles of consumption rates between the 24-hour and the FFQ approaches. The following discussion considers each of the items in turn.

Chance may be a partial explanation of the differences, but, due to the wide gap between means and percentiles by the two methods, the role of chance is likely to be small. The **reference**

period appears not to be a contributor to the difference, based on the lack of strong seasonal variation in the FFQ and 24-hour time series for species groups 1 and 2 and, surprisingly, the salmon species. See the seasonality material at the end of the section (5.23.2) on covariate selection, and related material in Appendix E, Section 9.4.1.

Concerning **memory**, the differential demand on memory of the two approaches is a plausible but not a proven factor in the observed difference in rates between the two methods. In the realm of memory, some side analyses suggest that the incidence of single and double hits (single and paired days with fish consumption) in the 24-hour data is too low to be consistent with the frequencies of consumption reported by the FFQ method[19]. It would be tempting to conclude, therefore, that the 24-hour incidence is more accurate than the FFQ consumption frequencies, because the 24-hour method requires less use of memory and interpretation than the FFQ method. But, it may take more surveys with these paired methodologies and further analysis of the data at hand from this survey to support or dispute the assertion of greater or accuracy of the 24-hour data.

The issue of **modeling** is difficult. The NCI method fits a consumption rate distribution to the 24-hour data as a whole (and, in this report, uses covariates). The important upper tail of the modeled distribution may or may not represent the true tail of the distribution well. The high fish consumers are in the data, of course, and do affect the fitted model. But, the expected 5% of consumers who have consumption rates beyond the population's 95th percentile are having an influence only along with the other 95% of the population and their representation among the respondents. Thus, the upper tail of the FFQ distribution should be studied to determine if there is strong skewness in it.

In summary, the NCI method's rates based on the 24-hour recall interviews are likely to be more accurate than the rates from the FFQ analysis due to the lighter demand on memory required by the 24-hour recall approach. Given that, in this analysis, memory is the primary candidate to lean on in favor of the NCI method, and given that memory and its imperfections are involved in producing both the FFQ data and the 24-hour data, and, finally, given that the memory exercise during the 24-hour interviews is less than that during the FFQ segment of the first interview, the NCI method can be favored, but the FFQ method should be considered as well, particularly the shape of the upper tail of the distribution of usual consumption. Additionally, the FFQ approach may be the only feasible method for development of FCRs for narrowly defined fish groups or for small surveys, for which the data needed to implement the NCI approach would usually not be available.

7.3 Comparison of This Survey's Rates to Other Surveys' Rates

[NPT]
Table 24 compares the Nez Perce rates from the current consumption survey (based on the FFQ and from the NCI method) to other similarly targeted tribal surveys, and also presents results of a survey of the U.S. National Population. All of the tribal survey consumption rates (mean,

[19] A comparison of portion sizes between the 24-hour and FFQ data has not been carried out.

median, and higher percentiles) are higher than that of the U.S. national population, usually by several-fold.

Table 24. Nez Perce Tribe. Total fish consumption rates of adults in Pacific Northwest Tribes (with consumption rates available) and the U.S. general population. Consumers only, g/day.

	No. of		Percentiles		
Population	**Respondents***	**Mean**	**50th**	**90th**	**95th**
Nez Perce Tribe, FFQ rates	451	123.4	70.5	270.1	437.4
Nez Perce Tribe, NCI method	451	75.0	49.5	173.2	232.1
Tulalip Tribes	73	82.2	44.5	193.4	267.6
Squaxin Island Tribe	117	83.7	44.5	205.8	280.2
Suquamish Tribe	92	213.9	132.1	489.0	796.9
Columbia River Tribes	464	63.2	40.5	130.0	194.0
USA/NCI	9,129	18.4	11.8	42.8	57.5

*Consumers only.
Data for populations outside of Idaho from CRTIFC,, 1994 (Columbia River Tribes), The Suquamish Tribe, 2000, Toy et al, 1996 (Tulalip and Squaxin Island Tribes) and Polissar, et al, 2014 (USA/NCI).

[SBT]
Table 24 compares the Shoshone-Bannock rates from the current consumption survey (based on the FFQ and from the NCI method) to other similarly targeted tribal surveys, and also presents results of a survey of the U.S. National Population. All of the tribal survey consumption rates (mean, median, and higher percentiles) are higher than that of the U.S. national population, usually by several-fold.

Table 24. Shoshone-Bannock Tribes. Total fish consumption rates (g/day) of adults in Pacific Northwest Tribes (with consumption rates available) and the US general population. Consumers only.

	No. of		Percentiles		
Population	**Respondents***	**Mean**	**50th**	**90th**	**95th**
Shoshone-Bannock Tribes, FFQ rates	226	158.5	74.6	392.5	603.4
Shoshone-Bannock Tribes, NCI method	226	34.5	14.9	94.5	140.9
Tulalip Tribes	73	82.2	44.5	193.4	267.6
Squaxin Island Tribe	117	83.7	44.5	205.8	280.2
Suquamish Tribe	92	213.9	132.1	489.0	796.9
Columbia River Tribes	464	63.2	40.5	130.0	194.0
USA, NCI method	9,129	18.4	11.8	42.8	57.5

*Consumers only.
Data for populations outside of Idaho from CRTIFC,, 1994 (Columbia River Tribes), The Suquamish Tribe, 2000, Toy et al, 1996 (Tulalip and Squaxin Island Tribes) and Polissar, et al, 2014 (USA/NCI).

7.4 Strengths and Limitations

[BOTH]
A major strength of the survey is that it utilized experts in every area needed to develop a credible survey. These areas of expertise included tribal culture, fisheries and fishing practices, survey design (including CAPI), survey administration, statistics, and government policy. In addition to the core technical staff working on the project, the project consulted with and utilized outside experts. The diversity of expertise provided was an asset because of the activities that needed support falling under each of the areas noted.

A synergy was realized when all of these parties were brought together to collaborate. Throughout the survey and during the current report-drafting phase, all of these individuals have been in constant and frequent communication. This close collaboration between the Tribe(s) and the contractor's staff along with the EPA and tribal organizations, as well as all of the many individuals that were required to bring the survey to fruition, is another strength.

Another source of confidence in the survey is the use of carefully trained tribal interviewers. Tribal members are more inclined to trust and open up to fellow members of their tribe than they are to outside interviewers. In addition, one of the contractor's staff (not a tribal member) developed an exceptional rapport with tribal members, greatly increasing their effectiveness at coordinating survey implementation and allowing them to carry out interviews to increase the respondent count.

The re-interview analysis shows that while individuals vary over time in responses to the same questions, the summary means and percentages are reasonably similar to each other from interview and re-interview. For the two most important items—because they are related to computation of fish consumption rates, the difference between interview and re-interview was moderate to small. [NPT]Consumption of Chinook salmon (the most frequently consumed species) was reported as 97% of the re-interview sample on their first (regular) interview and 94% on re-interview. The mean frequency of consumption of Chinook salmon (computed as number of times per year) was 30.7 vs. 30.9. [SBT] Consumption of Chinook salmon (the most frequently consumed species) was reported as 93% of the re-interview sample on their first (regular) interview and 83% on re-interview. The mean frequency of consumption of Chinook salmon (computed as number of times per year) was 15.5 vs. 19.7. [BOTH]This survey is intended to provide summary consumption statistics, such as means and percentiles. The re-interview analysis supports the use of that purpose with these interviews, though significant variation by an individual in responses (to an identical question) over time is evident.

[NPT]
We also found that use of outside interviewers was effective and increased the total number of interviews, due to their activities being shepherded and supported by the Tribe. First contacts for interviews were usually made by tribal members. In addition, the outside interviewers were directed only to potential respondents who were staff members of the Tribe. This practice made finding the potential respondents easier and, also, put the interviewers in touch with a group of

tribal members who usually had more contact with the people outside the Tribe. As described in section 6.7, the potential impact of non-tribal interviewers on responses was examined and no significant differences in overall consumption rates were found between respondents with a tribal or non-tribal interviewer.

[BOTH]
Another strength of the survey was the use of the CAPI interview mode, which, as noted previously, greatly enhances survey accuracy and completeness. The interview results were usually available very shortly after the interview itself based on synchronizing the CAPI tablet online with the contractor's website.

Survey accuracy and completeness is increased by CAPI, compared to other modes, because:

- There are fewer "touches" on the data. With a paper and pencil questionnaire, the interviewer records the respondent's answer, and later a data entry clerk enters the data in a tabulation program. CAPI needs only one data recording source: the interviewer.
- With CAPI, the interviewer and respondent use facial cues and other physical observation, looking for items that the respondent might not understand, and clarifying as appropriate. The telephone and self-administered modes have fewer means of assessing and addressing respondent confusion.
- Computer programming and skip logic conditions are automated, allowing the interviewer to focus on the respondent. A paper questionnaire, whether self-administered or administered by an interviewer, relies on the sometimes fallible human to check and administer real-time skip patterns during the interview.
- Out-of-range values and logic checks are evaluated immediately by the computer. Paper and pencil questionnaires cannot offer this degree of quality assurance.
- Data from the CAPI system is uploaded as soon as an internet connection is available. This provides both a back-up (in case a computer tablet is lost or stolen) and a means for the statisticians to check the integrity of the data.
- CAPI data collection is transportable. Interviewers can bring the computer tablets to far-flung areas, even households without landlines or cell phone coverage. Telephone interviews and online interviews only work where there is phone or internet access, respectively.
- CAPI technology requires no technical knowledge or ability from the *respondents*. Interviewers are trained to use the computer tablets unobtrusively and without respondent assistance, other than asking for answers to survey questions. Online surveys dictate that each respondent has at least basic computer experience and knows how to navigate the internet.

An additional strength of the survey was the level of detail obtained on consumption by species. Approximately 45 individual species were named, and additional species could be reported by respondents and entered into the database using a text field. All such entries were used in preparing this report.

Yet another strength of the survey was the span of time during which the survey was carried out, covering multiple periods of fish runs and seasons. The representation of all seasons in the

survey allowed an assessment of seasonal effect on FFQ consumption responses. Analysis did not show that a seasonal adjustment was needed to provide valid consumption rates, but the coverage of seasons during a year of interviewing is some insurance against bias. While ideally a retrospective fish consumption rate covering the past year and drawn from the respondent's memory (i.e., the food frequency approach) should be fairly constant over time, in fact the consumption of the preceding year reported during interviews at the beginning of the survey year could be quite different than the consumption in the preceding year reported at the end of the survey year. Thus, spreading the surveys over almost a full calendar year covered a great deal of outside variation in access to information about the harvesting of fish. Relative to extant fish consumption surveys in EPA Region 10, this is one of the first to collect FFQ information over a year[20].

A further strength of the survey was the use of a well-defined frame for drawing the sample. The Tribe(s) had a complete roster of all members with some demographic information as well as some contact information, which provided a valuable frame for drawing the sample. It was, in fact, the only existing list of tribal members. Use of this list avoided costly development of an alternative sampling frame.

The use of the NCI method to estimate the distribution of usual fish consumption is another strength. It involves less reliance on memory (but more reliance on modeling) than the FFQ approach. A side benefit to using the NCI method is that it requires a minimum number of double-hits to provide reasonable assurance of fitting a model. This provided an additional motivation for interviewers and staff to increase the number of completed interviews. The results of the NCI method were thoroughly vetted through additional quality assurance methods, sensitivity analyses and parallel and independent calculations by two statisticians for many of the consumption rate analyses presented—both for the FFQ and NCI methods.

A limitation of the survey is that a number of cases had missing data which had to be imputed to be able to retain the respondent's other responses for inclusion in the survey. Usually the much less frequently consumed species had such missing values, though this was not exclusively the case. An analysis showing the sensitivity of estimated mean consumption, as well as the median and other percentiles, showed quite a minor impact of the imputations. See Appendix C for the sensitivity analysis.

The response rate for the survey was lower than expected. It is often difficult to know the reasons for non-response, as these are the individuals who do not participate; typically, they do not divulge their rationale for lack of cooperation. To no small effect, limitations on resources and time (to adequately find and contact some respondents) contributed to a lower response rate. Resources, intended for the interviewing task, were necessarily diverted to locating and contacting prospective respondents. The survey team experienced considerable difficulty locating, and thus interviewing, tribal members. The team also experienced challenges with missed appointments. Some Tribal members scheduled interviews in their homes, but then decided not to do them, or postponed them for another time and location—a postponement which did not always have a successful ending.

[20] EPA Region 10 includes Alaska, Idaho, Oregon, Washington and Native American Tribes in these states.

Contributing to the difficulty of respondent contact was outdated, incorrect or missing information. Enrollment offices provided membership lists but sometimes without accurate phone numbers or addresses. The survey team employed supplemental methods to search for Tribal members, including checking property records, utility records and commercial databases and online searches. Some Tribal members lived "off the grid," in areas without physical, mailing addresses. Others had addresses which were merely "Rural Route." Even Tribal interviewers, who had direct and in-depth knowledge about Tribal members, experienced significant difficulty when it came time to locate some members.

A counterbalancing strength to the moderately low response rate is that the weighting method used to estimate the population distribution of consumption rates would usually correct for a potential selection bias, to the extent that the contractors were able to use variables characterizing selection bias and adjusting for it.

An additional fact, not necessarily a limitation, is that the target population was based on ZIP codes and distance to tribal centers. While it does make sense to exclude tribal members who live at a great distance from the reservation, there is no clear cutoff as to who should be included or excluded based on geographic considerations, especially considering that the data will be used in the effort to protect the health of tribal members and other residents in all of Idaho, especially those who have high levels of fish consumption.

7.5 Characterizing Uncertainty

[BOTH]
The confidence intervals for percentiles of consumption rates in the study describe the uncertainty in various FCR statistics. The width of these confidence intervals should be taken as advisory, without a specific cutoff of widths considered to be desirable or undesirable among the confidence intervals presented in this report. Again, the data are valuable and, as a practice, the estimated means and percentiles are the best choice to use for practical purposes as opposed to other values in the confidence interval. Based on methodologic principles used to avoid bias, the point estimate (the estimated value lying within the confidence interval) is the preferred estimate to use in practice and not other values in the confidence interval.

The statistical weights were adjusted for non-response to correct for any selection bias. It cannot be guaranteed that selection bias has been completely addressed, as not all non-response can be predicted, but all available demographic variables were considered in making the nonresponse adjustment. Furthermore, the additional uncertainty in consumption rates due to imputation of missing fields in a limited number of cases is not fully represented in the confidence intervals. However, the ultimate impact of imputation was found to be small based on a sensitivity analysis encompassing a wide range of imputation scenarios. In summary the use of imputation was important to avoid deletion of a number of respondents' consumption from the analysis, but the different choices for imputation, varying around the parameter values chosen, had little effect on means and percentiles of consumption rates.

The findings on seasonality—actually, a possible lack of seasonal variation—were unexpected (see Section 5.23.2). This finding was unexpected because fishing activity, as reported in this survey, did vary by season, as shown in Figure 5. Interviewers also sometimes reported difficulty reaching sampled members because they were away, fishing. The CRITFC report also showed strong seasonal variation in reported consumption of species obtained from the Columbia River Basin. Analysis of data from this survey showed no discernible seasonal patterns—that differed from 'noise'—in consumption rates for the species groups analyzed, including salmon (all salmon and steelhead species combined). The sample sizes were too small to rule out seasonal variation, but there was no pattern that could be used to create a method for seasonal adjustment of the consumption rate distributions. It is possible that a large fraction of the tribal members tend to be fairly steady over time in their fish consumption rate. A fairly steady consumption rate could be managed if tribal members alternate species according to availability (by harvest or purchase), and, also, draw on preserved or otherwise stored harvest from peak periods of availability.

7.6 Next Steps, Lessons Learned

[NPT]
A very important lesson learned was the critical role of the tribal staff and Council, who played a significant role in increasing the number of interviews achieved. The Tribe was pivotal in assisting the contractors in developing a strategy and making refinements to obtain more completed interviews. The Tribe provided incentives to members—such as a raffle—to participate in the survey, organized mailings and periodic mass e-mails, and approved administrative leave for staff to participate in interviews. In addition, tribal staff provided assistance and oversight for on-site interviews (e.g., snacks, interview facilities, administrative support, calling and arranging interviews and free, attractive t-shirts for many interviewees). Without these measures, the total number of interviews would have been less than the number achieved. The mailings and other publicity were reviewed by the contractors to ensure that the content would not introduce any bias into respondents' reporting of fish consumption.

[SBT]
A very important lesson learned was the critical role of the tribal staff and Council, who played a significant role in increasing the number of interviews achieved by offering incentives, publicity and practical help and advice. The tribal staff also freely offered consultation, advice and the fruit of their collective experience on the many occasions when the survey team needed that resource.

7.7 Conclusions

[NPT]
The Nez Perce Tribe is a high fish-consuming population, relative to the general U.S. population and other Pacific Northwest tribes. The population of documented fishers within the Tribe has even higher fish consumption rates than the overall tribal population. There has been a substantial reported change in access to fish and fishing according to tribal respondents, and the

largest change is that a much larger proportion of the population has experienced a decrease in access to fishing than the proportion of those experiencing an increase in access.

Results obtained via the NCI method are likely more accurate than FFQ results; however, when sample size or resources cannot support the NCI method, the FFQ approach may be used.

A lesson learned from the survey activity is the importance of strong support from the tribal leadership and staff in order to achieve acceptance of the survey and higher response rates.

[SBT]
The Shoshone-Bannock Tribes are a high fish-consuming population, relative to the general U.S. population and other Pacific Northwest tribes. The fishers within the Tribes share these high consumption rates. There has been a substantial change in access to fish and fishing according to tribal respondents, and the largest change is a decrease in access to fishing for many more of the tribal members than those reporting increased access.

Results obtained via the NCI method are likely more accurate than FFQ results; however, when sample size or resources cannot support the NCI method, the FFQ approach may be used.
A lesson learned from the survey activity is the importance of strong support from the tribal leadership and staff in order to achieve higher response rates.

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List of Appendices

Note: This appendix (design document) will be included in the final report at the time of the final report's release.